# 4. RESULTS

## 4.1 Preliminary evaluation Trials

### *4.1.1 Variability*

The ANOVA for different characters measured in a total of 64 varieties of chillies are shown in Table 4.1. For traits such as conversion rates, ease of drying and quality characters such as colour and capsaicin content, the number of varieties available for analyses is less than 64. Analyses for ease of drying and conversion rate were conducted on a 200g sample. Consequently four varieties namely Ch272 (V4), Chilli 3110 (V22), Chinese Ch260-A (V26) and Ch260-B (V27) which produced less than 200g per harvest had insufficient samples for analyses. For analyses of capsaicin and colour of the product, 5g sample was required per analysis. The yield of V27 was so poor, it was insufficient to meet even the minimum requirement needed for the analyses. Besides, V27 also produced fruits that were not representative of the varietal fruit characteristic hence, data on V27 were not included in the analyses for fruit characters.

Significant varietal differences were observed in yield per plant, dry yield per plant and in yield components: number of fruits/plant and mean fruit weight. Fruit morphological characters such as fruit length, fruit shape index, mesocarp thickness, number of seeds per fruit and petiole length also showed significant varietal differences. Similarly, significant differences were observed in days to harvest, plant height, plant spread, plant shape index, conversions of dry weight from fresh weight (computed from dry weight of solid content) and ease of drying as reflected by days taken to dry. Differences in varieties were significant in quality factors namely capsaicin level, colour retention (reflected by percentage of bleaching) and colour of product (reflected by light absorption). Such diverse variability provides good opportunity for selection.

Table 4.1. Mean Squares values (d.f. within parenthesis) for the various traits of chilli in the preliminary evaluation trials.

| Traits | Mean squares (d.f) | | | | | |
|---|---|---|---|---|---|---|
| | Varieties | | Rep | | Error | |
| Yield (fresh) (g/plant) | 104139.38 *** | (63) | 628845.25 *** | (3) | 33087.81 | (189) |
| Dry yield (g/plant) | 2865.91*** | (59) | 24353.95 *** | (3) | 1243.82 | (177) |
| Number of fruit /plant | 48365.05*** | (63) | 166108.29*** | (3) | 12173.11 | (189) |
| Mean fruit weight (g/frt) | 150.80*** | (63) | 118.90 *** | (3) | 13.47 | (189) |
| Fruit length (cm) | 11.80*** | (62) | 18.89 *** | (3) | 2.40 | (168) |
| Fruit width (cm) | 0.91*** | (62) | 0.121 | (3) | 0.21 | (168) |
| Fruit index | 10.5*** | (62) | 22.42*** | (3) | 2.13 | (183) |
| Fruit stalk (cm) | 1.4*** | (62) | 2.19** | (3) | 0.56 | (183) |
| No of seeds/fruit | 3470.0*** | (62) | 1337.06 | (3) | 618.26 | (183) |
| Flesh Thickness (mm) | 0.88*** | (63) | 0.031 | (3) | 0.021 | (189) |
| Days to harvest | 247.84*** | (62) | 386.81*** | (3) | 61.27 | (183) |
| Plant height at 1st harvest (cm) | 623.76*** | (63) | 51.72 | (3) | 83.08 | (187) |
| Plant spread at 1st harvest (cm) | 386.79*** | (63) | 37.51 | (3) | 96.99 | (187) |
| Plant shape (spread/height) | 0.16*** | (63) | 0.01 | (3) | 0.02 | (187) |
| Days to dry (days) | 9.21*** | (59) | 8.30 * | (3) | 2.38 | (177) |
| Conversion rate | 50.06*** | (59) | 26.33 | (3) | 14.29 | (177) |
| % of bleaching | 0.053*** | (59) | 0.064 ** | (3) | 0.021 | (177) |
| Light transmission | 0.134*** | (62) | 0.048 | (3) | 0.05 | (183) |
| Capsaicin (mg/g) | 1.27 * | (62) | 0.67 | (3) | 0.901 | (183) |

Fruit shape index @ fruit length (cm)/fruit width (cm)
Days to harvest @: No of days from transplanting to first harvest
Plant height @ the height from the ground to tip of the plant in natural stature.
*, **, *** @significant at $P \leq 0.05(5\%)$, $P \leq 0.01(1\%)$, $P \leq 0.001(0.1\%)$ respectively

*4.1.2. Mean performance*

*a) Yield, yield components and fruit characteristics*

Yield is an important consideration for any breeding programme. The 64 varieties showed a great variation in yield (fresh weight), ranging from 3.0 to 629.0 g/plant (Table 4.2). The ten varieties which produced less than 100g/plant were Indian Sanam (V64), Chinese Xian (V25), local Ch288 (V23), Local Japanese (V35), Japanese Ch385 (V54), Cili3110 (V22), Ch272 (V4), Chinese Ch260A (V26) and Chinese Ch260B (V27). Except *cili padi* like Ch288, they are all exotic dry chilli varieties and early varieties. Some varieties fruited even before transplanting. This could be the possible cause of the low yield of varieties such as Chinese Xian, V54, V35, V26 and V27. Some varieties namely V54, V35 and V22 were also affected by severe disease problem. These exotic varieties showed poor adaptation and generally poor performance in Jalan Kebun.

One of the locally popular varieties, Kulai (V40), produced only 326 g/plant. Several varieties were found to supersede Kulai and those varieties which produced more than 400 g/plant were Ch388 (V57), MC4 (V63), Ch248 (V18), Ch384 (V53), Ch393 (V61), Ch 901-166-3 (V17), Ch389 (V58), Tanjung Minyak (V42) and Ch291-1-4-18 (V48). With the exception of line Ch 291-1-4-14 (V48), they are all local cultivars showing vigorous and prolific growth with succulent fruits and are among the tall and medium size plants.

For dry chilli production, it is important to examine dry weight yield. This was estimated by yield (fresh weight) x conversion rate. The ten leading varieties, in terms of dry yield (>80 g/plant) were Ch388(V57), Purple Chilli (V16), V53, MC4, exotic Ch 248 (V18), Indonesian Brebes (V44), Thai Ch252-C-P (V49), Ch389 (V58), Ch

254(V9) and Brebes (V44) Lombok Ch284-6 (V15) (Table 4.2). As expected, some of these varieties differed slightly from that of the fresh yield. Among these top yielders, exotic Purple Chilli, Indonesian Brebes, Thai V49 and Lombok V15 were either double purpose or dry chilli varieties.

With regards to number of fruits, the varieties showed a wide range of values between 4.3 to 221.0 fruits/plant, with the top yielders producing more than 60 fruits per plant. It is apparent here that number of fruit contributed to yield. Number of fruits also appeared to some extent to be influenced by the mean fruit weight (Gomez-Guillamon and Cuartero 1986; Nandpuri *et al.* 1970). Fruit size is inversely proportional to fruit number. The plant with big fruit (>10 g/fruit) produced about 76 fruits per plant, medium fruits (6-9 g/fruit) produced as high as100 fruits per plant while those with small fruits (< 6g/fruit) recorded very high fruit number of more than 100 fruits per plant. The greater the fruit size the lesser the number of fruits per plant or vise versa were observed.

For mean fruit weight, the varieties showed variation ranging from 0.7g to 14.6 g per fruit. Big fruit (>10g/fruit) appeared to derive from fresh fruit varieties and majority of them were of local origin. They included varieties V53, Tanjung Minyak (V42), Langkap (V41), Hantaka (V36), Local Ch388 (V57), local V59, V18, local V8, Langkap selection (V14), Lombok selection (V12), Langkap selection (V11), local V58, Langkap selection (V13), local selection (V60), Sarawak selection (V2), *cili akar* (V34) and Agasia 6 (V6). Next in size were double purpose varieties from mixed origins. These included local MC11 (V46), dry chilli Agasia Ch280 (V47), Korean dry chilli V48, Korean selection Ch256 (V33), Korean selection Ch291-P (V1), Korean Jinsol (V20), Indonesian Lombok (V15) and Indian Sanam (V64). They produced reasonably good fruit size with mean fruit weight between 7.1-8.9 g/fruit. The exotic dry chilli varieties appeared to produce medium, small to very small '*cili padi*' like fruits. The medium to small fruited were local V43, exotic Purple Chilli (V16), Thai dry chilli Ch252-A (V29), Thai dry chilli Ch252-B (V30), Korean double purpose chilli Ch291 (V32), Thai dry chilli Ch252-C-P, Indonesian dry chilli Brebes, exotic dry chilli Ch387 (V56) and Chinese dry chilli Xian (V25) showed mean fruit weight 3.5 -5.7 g/fruit while the dry chilli varieties which resembles '*cili padi*' (<3.5 g/fruit) were Thai Huey Sithon, exotic Ch386 (V55), Japanese selection (V54), Indonesian *cili akar* V34, Thai Ch252-C(V28), Taiwan dry chilli (V38), Japanese Hantaka, Thai dry chilli (V37), local Japanese dry chilli V35 and Chinese dry chili V24. Some of the dry chilli top yielders were in this group. It appears that small to medium size fruits were also promising.

Mean fruit length (Table 4.2) varied from 3.7 cm to 11.9 cm. All the exotic dry chilli varieties showed fruit length longer than SIRIM standard of marketable length for '*cili besar*' which is 7cm, except for V37, Huey Sithon, Taiwan dry chilli, Hantaka and V54. They were shorter, with length between 3.7- 4.6 cm.. These were meant for chilli powder. Wide range between 0.7 to 3.3 cm was observed in fruit width, with majority of varieties showed fruit width of around 2.0 cm. Dry chilli varieties showed narrower fruit width between 0.8-1.5 cm compared to more than 2.0 cm of fresh fruit varieties. Fruit shape index, the ratio of the fruit length against fruit width, exhibited ratios ranging between 2.7-12.4. Being more fleshy and broad, fresh chilli appeared to record lower fruit shape index compared to that of dry chilli varieties. In general, most of the dry chilli varieties were slimmer and longer fruits with higher fruit index of more than 5.0 and especially the longer fruits appeared to have wrinkled surface.

The mean seed number per fruit is important since it contributes to conversion rate. The seed number per fruit showed means ranging between 41.8 and 142.7 seeds/fruit. Comparatively, dry chilli varieties appeared to have higher mean seed number per fruit than that of fresh varieties. Flesh or mesocarp thickness is directly related to industrial yield. It follows therefore that variety with thick flesh and low water content in the flesh is the most suitable for processing. Such variety would give high conversion rate and would take less time to dry. Mean values ranging between 0.6 to 2.2 mm was observed for flesh thickness. With the exception of the Korean varieties, Ch291-P (V1) and Ch291 (V32), dry chilli varieties exhibited thin mesocarp.

Parameter conversion rate is computed from the weight of the solid content. The importance of conversion rate is clearly spelt in the production of raw material. Conversion rate reflects the amount of the processed product. The higher the conversion rate the more economical and more suitable is the variety for drying purposes. Earlier finding had indicated that conversion rate of 15% (from fresh to dry) is the break-even point. About 91% of varieties tested showed conversion rates of more than break even (15% of dry weight). Poulos (1992) considered those chillies with conversion rates of 25% and above were ideal for dry chilli production. The varieties which come under this category include Thai Huey Sithon with conversion rate of 30%. This was followed by Chilli *akar* (V34), Chinese V24, Thai Ch252-C, Thai V37, Japanese selection Ch385, Thai Ch252-C(P), local *cili padi* like Ch288 (V23), Indonesian Purple Chilli (V16), Ch234-13(V14), Taiwan dry chilli, Korean V32, Lombok (V15), Local Ch254, Chinese Xian (V25), Sri Lankan (V31), local MC11, Hong Il Pum (V3), Ch252-B(V30), Chilli 3107-2(V19) and Japanese

Hantaka(V36). The latter five varieties showed conversion rate of above 20%, considered acceptable by local standard. All these were either dry chilli or double-purpose chilli varieties. Majority of the varieties with high conversion rates were small fruits. Most of the fresh chilli on the other hand showed comparatively, lower conversion rate than those of dry chilli.

The time taken by the chilli fruits to dry is considered important in dry chilli production. The longer the chilli is in wet stage, the higher is the chance for chilli be infected by diseases. Besides, the faster it takes the variety to dry the more economical and more suitable is the varieties for the production of dried chilli. Using modified raised trays, our chilli recorded a ranges between 10-17 days to dry. All the known dry chilli varieties dried faster. Japanese Hantaka (V36), and Thai Huey Sithon (V39) were the fastest to dry, requiring about 10 days. Both are upright varieties. Chinese V25 and Indian V64, pendent varieties also showed fast drying period of about 10 days. It is interesting to see that Korean Jinsol (V20), though showed considerably thick mesocarp of 1.8 mm required only 10 days to dry. Other Korean varieties such as V1, V32 with mesocarp thickness of 1.65 and 1.5 mm respectively also recorded reasonably short drying period of about two weeks (14 days). Others known dry varieties that recorded less than two weeks to dry were Thai V28, Indonesian *chilli akar* (V34), Brebes, local Ch254 (V9), Indonesian Lombok (V15), Ch234-1 (V11), exotic V56, exotic Agasia 5 (V5) and Taiwan dry chilli.

*b) Agronomic characters*

Characters namely days to harvest, plant height, plant spread and plant shape index were important agronomic characters. Values for days to harvest, plant height, plant spread and plant shape index were shown in Table 4.2.

Parameter days to harvest reflects the maturity. This information enables the grower to schedule the crop accordingly so as to avoid harvesting during unfavourable rainy period. Planting early maturity variety, make it possible for the crop to be harvested before the onset of diseases particularly virus, hence the crop escapes serious damage. Mean values for days to harvest ranged between 76.8 and 117.3 days after transplanting. Most of the exotic varieties were early varieties, some even started fruiting while in nursery. Among the early varieties were V32 (Korea), Agasia-3 (V3), Lombok (V15), Jinsol (V20) and Xian (V25) from China. They recorded 77-86 days to harvest. Local variety MC4 took about 80 days to harvest.

Growth habit determines the spacing and to some extent the appropriate cultural practices and also influence the microenvironment of the plant. Microenvironment with good aeration is less conducive for disease, especially fungal diseases. Those with plant stature of '7' or '5' (as in chilli descriptor list by IPBGR shown in Appendix I) and those with wider plant spread appeared to give higher yield. For plant height, mean values ranging between 31 cm to 80 cm was recorded. Generally, tall plants recorded higher yield, unfortunately, when grown on loose soil such as peat they become less sturdy and liable to lodging. Under this circumstance, medium height (60-75m) varieties would be more preferable as tall varieties required staking consequently increase production cost. A range of 24.0 to 72.3 cm was recorded for canopy spread. Canopy spread dictates planting distance. It was observed that varieties with very narrow canopy spread recorded lower yield while canopy spread of 60 cm or more tend to produce higher yield/plant. Too wide a canopy spread reduces plant stands, which in turn results in yield reduction per ha.

*c) Quality factors*

Colour retention, colour of fruit and ease of drying as reflected by percentage of bleaching, light absorption, days taken to dry respectively and capsaicin level contribute to quality. The ANOVA on quality characters in Table 4.2 showed significant varietal differences on days to dry, conversion rate, light absorption, percentage of bleaching and capsaicin.

Light absorption measures colour of the product. A range of light absorption between 2.88 -1.9 of a/b hue unit measured at wavelength 485 nm was presented in *Table 4.2* The darker is the colour the higher is the value of a/b. V61 showed the highest value. This is not surprising since Ch393 (V61) is a dark red fruit. Colour of the product shown narrower range as compared to colour retention on drying which is given by percentage of bleaching. For percentage of bleaching, value as high as 53% was recorded by V1 to as low as 2.7% recorded by V39. The higher the percentage of bleaching the lower is colour retention. Conversely, the lower is the percentage of bleaching, the higher is the colour retention and more desirable is the varieties. Varieties with high colour retention of less than 10% bleaching after drying in descending order were Huey Sithon (V39), Thai chilli for powder (V37), local Ch288 (V23), Ch386 (V55), Purple chilli, *Cili akar* (V34), MC11, Hong Il Pum (V3), Agasia5 (V5), Sri Lanka (V31), Brebes, Ch252-C-P, Xian Ch258 (V24), V35, Ch387 (V56), Xian Ch257 (V25), Chilli 3109(V21) and Lombok (V15). They were all exotic dry chilli varieties.

Varietal differences existed in capsaicin level in chilli (Table 4.2). Pungency differences were observed between varieties. Capsaicin values between 5.0 to 1.67 mg/g dry weight were observed under this experimental condition. Varieties which record capsaicin level between 3.0-5.0 mg/g dry weight of chilli are considered pungent chilli. Under this classification, most of the tested varieties fall in this category are small fruited varieties namely V23 (5.0), V30 (4.4), Thai V49 (4.4), Thai V28 (4.1), Thai V37 (4.1), V55 (3.9), Huey Sithon (3.9), Hong Il Pum (3.8), Ch234-13 (V14)(3.7), V58 (3.6), V21 (3.6), V59 (3.5), V54 (3.5), V8 (3.5), V56 (3.5), V2 (3.3), Brebes (3.3), Ch252-A (V29)(3.2), Korean Ch291 (V32), Ch279 (V7), Chilli 3107-2(V19), local selection R1-20-P4 (V10), V48, Ch248-901 (V18), *Cili akar* V34, V13, V43, V62, V5, and V24. Of the big fruits, considerable high capsaicin level were recorded by local varieties such as V57 (4.1mg/g), V14 (3.7), Ch234-11 (V13), Ch393 (V61) and Kulai.

It is evident that varietal differences existed in the characters tested. Observed variations between genotypes indicate there are basis for selection for superior genotypes. When the varieties were ranked according to yields, conversion rate, ease of drying, pungency and fruiting habit (Appendix I), varieties Ch291-P (V1), Ch254 (V9), Ch284-6 (V15), Purple Chilli (V16), Ch252-CV (28), Sri Lanka (V31), Ch291 (V32), Hantaka (V36), Taiwan dry chilli (V38), Huey Sithon (V39), Kulai (V40), MC11 (V46), Ch252-C-P (V49), Ch385 (V54), Ch387 (V56), Ch393 (V61), MC4 (V63) and Indian Sanam (V64) appear to meet some if not all the selection criteria. It would be interesting however, to see the stability of the performance of these genotypes under various environments.

Table 4.2. Mean values of some chilli characteristics measured in the preliminary trial evaluated in Jalan Kebun

| Code | Varieties/ accession No | Yield (g/plt) | Dry yield (g/plant | No. of Fruit/ plant | Mean fruit wt (g) | Fruit length (cm) | Fruit Width (cm) | 1/ Fruit shape index | Fruit stalk (cm) | Seeds/ fruit | Mesocarp Thickness (mm) | DH (days) | GH | Plant height (cm) | Plant spread (cm) | 2/ Plant shape | DD (days) | Con (%) | Bleach (%) | Light 3/ absorb at 485 nm | Capsaic in mg/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V1 | Ch291P* | 340.0 | 62.9 | 53.4 | 8.8 | 6.7 | 1.6 | 5.0 | 2.8 | 96.6 | 1.65 | 103 | 5 | 54.0 | 43 | 0.79 | 13.3 | 19.0 | 53 | 2.4 | 1.7 |
| V2 | Ch221 | 373.0 | 58.1 | 48.0 | 10.5 | 7.4 | 2.1 | 3.5 | 3.0 | 107 | 1.8 | 104 | 5 | 67.0 | 56 | 0.83 | 14.0 | 15.6 | 15.8 | 2.8 | 3.3 |
| V3 | Hong Li Pum | 211.0 | 43.0 | 65.0 | 5.3 | 6.3 | 1.4 | 4.5 | 2.4 | 97.4 | 2.0 | 83 | 5 | 40.0 | 39 | 0.96 | 15.0 | 20.3 | 7.3 | 2.7 | 3.8 |
| V4 | Ch272 | 38.0 | n.a | 7.8 | 8.1 | 7.8 | 1.8 | 4.4 | 2.6 | 87.4 | 2.0 | 117 | 3 | 53.0 | 50 | 0.94 | n.a | n.a. | n.a | 2.3 | 2.3 |
| V5 | Ch274 | 236.0 | 39.2 | 42.8 | 9.3 | 8.9 | 1.7 | 5.0 | 2.9 | 100.8 | 2.0 | 101 | 3 | 76.0 | 71 | 0.93 | 16.0 | 16.7 | 8.3 | 2.7 | 3.1 |
| V6 | Ch278 | 246.0 | 41.0 | 55.0 | 10.3 | 8.8 | 1.9 | 5.0 | 2.8 | 119.8 | 2.0 | 99 | 5 | 53.0 | 55 | 1.03 | 15.7 | 15.8 | 22.1 | 2.7 | 1.9 |
| V7 | Ch279 | 284.0 | 58.3 | 42.0 | 9.6 | 8.7 | 2.1 | 4.3 | 3.5 | 81.4 | 2.0 | 98 | 7 | 72.0 | 57 | 0.79 | 17.3 | 18.0 | 24 | 2.6 | 3.2 |
| V8 | Ch204 | 366.0 | 51.1 | 48.4 | 11.4 | 10.2 | 1.8 | 5.2 | 3.2 | 142.6 | 2.0 | 103 | 3 | 73.0 | 67 | 0.92 | 15.0 | 16.2 | 15.1 | 2.6 | 3.5 |
| V9 | Ch254* | 348.0 | 80.0 | 97.9 | 5.1 | 7.3 | 1.5 | 5.1 | 2.8 | 68.4 | 1.8 | 103 | 5 | 54.0 | 58 | 1.06 | 16.6 | 22.5 | 18.3 | 2.8 | 2.2 |
| V10 | R1-20-P4-31 | 295.0 | 50.2 | 49.1 | 8.3 | 7.2 | 2.1 | 3.4 | 3.0 | 123.8 | 1.8 | 105 | 7 | 71.0 | 56 | 0.79 | 14.7 | 17.0 | 10.6 | 2.9 | 3.2 |
| V11 | Ch234-1 | 311.0 | 50.1 | 41.0 | 10.8 | 11.9 | 2.3 | 5.6 | 3.4 | 82.8 | 1.7 | 106 | 3 | 57.0 | 53 | 0.94 | 13.7 | 16.1 | 23.7 | 2.8 | 3.0 |
| V12 | Ch284-4 | 268.0 | 49.1 | 46.8 | 10.9 | 10.0 | 2.0 | 5.0 | 3.0 | 72.2 | 1.8 | 88 | 1 | 49.0 | 66 | 1.36 | 15.0 | 18.3 | 16.6 | 2.3 | 2.7 |
| V13 | Ch234-11 | 220.0 | 35.2 | 29.9 | 10.7 | 9.9 | 2.1 | 4.7 | 3.4 | 93.6 | 1.8 | 108 | 7 | 67.0 | 50 | 0.75 | 16.3 | 15.9 | 19.8 | 2.7 | 3.1 |
| V14 | Ch234-13 | 243.0 | 39.1 | 34.3 | 11.3 | 9.3 | 1.8 | 5.7 | 3.5 | 86.4 | 1.73 | 106 | 7 | 56.0 | 44 | 0.8 | 15.2 | 16.1 | 16.7 | 2.7 | 3.7 |
| V15 | Ch284-6* | 340.0 | 80.0 | 94.6 | 7.1 | 7.7 | 1.5 | 5.5 | 2.1 | 112 | 1.8 | 83 | 5 | 53.0 | 62 | 1.17 | 14.7 | 23.4 | 10.5 | 2.6 | 3.0 |
| V16 | Purple Chilli* | 341.0 | 95.6 | 76.9 | 5.4 | 9.2 | 1.3 | 7.6 | 3.0 | 63.8 | 1.3 | 97 | 3 | 59.0 | 63 | 1.07 | 13.5 | 27.5 | 1.9 | 2.7 | 3.3 |
| V17 | 901-166-3 | 497.0 | 78.5 | 87.1 | 8.7 | 8.8 | 2.0 | 4.5 | 4.0 | 57.6 | 1.73 | 89 | 3 | 65.0 | 66 | 1.02 | 13.0 | 15.8 | 51.5 | 2.8 | 2.6 |
| V18 | Ch248(901) | 541.0 | 93.9 | 83.8 | 11.5 | 9.7 | 2.3 | 4.4 | 4.0 | 110.2 | 1.8 | 88 | 7 | 76.0 | 66 | 0.88 | 14.3 | 17.3 | 15.2 | 2.8 | 3.2 |
| V19 | Chilli3107-2 | 140.0 | 24.2 | 51.5 | 3.2 | 7.2 | 1.4 | 5.3 | 2.6 | 68.8 | 1.1 | 101 | 3 | 42.0 | 42 | 0.99 | 11.0 | 20.0 | 10.9 | 2.8 | 3.2 |
| V20 | Jinsol | 188.0 | 25.8 | 53.0 | 6.3 | 8.1 | 1.5 | 5.4 | 2.2 | 115 | 1.8 | 84 | 1 | 48.0 | 63 | 1.32 | 15.0 | 13.7 | 11.3 | 2.5 | 2.4 |
| V21 | Chilli3109 | 183.0 | 34.3 | 62.3 | 4.0 | 5.4 | 1.4 | 4.0 | 2.3 | 69.8 | 1.8 | 92 | 5 | 40.0 | 41 | 1.02 | 14.3 | 18.7 | 10.1 | 2.5 | 3.6 |
| V22 | Chilli3110 | 41.0 | n.a | 14.6 | 3.9 | 6.2 | 1.8 | 3.7 | 2.4 | 50.4 | 1.0 | 89 | 1 | 42.0 | 61 | 1.47 | n.a. | n.a. | n.a | 2.6 | 2.4 |
| V23 | Ch288 | 82.0 | 21.2 | 80.9 | 0.9 | 3.7 | 0.8 | 4.5 | 2.7 | 69.8 | 0.7 | 104 | 3 | 55.0 | 53 | 0.98 | 13.3 | 24.2 | 4.2 | 2.0 | 5.0 |

* genotypes selected for multilocational trial ; 1/ fruit shape index @ ratio of the length to diameter taken at the middle portion of the fruit.; 2/ plant shape @ plant spread/plant height. 3/absorb @absorbtion n.a @ not available - insufficient sample to carry out analysis. DD @ days to dry; DH days to harvest; Plant shape index @ the ratio of plant spread to plant height; GH@ growth habit refer to Appendix 1

Table 4.2. (Continue) /

| Code | Varieties/ /accession No. | Yield (g/plt) | Dry yield (g/plt) | No.fruit per plant | Mean fruit wt (g/fruit) | Fruit length (cm) | Fruit Width (cm) | Fruit shape index [1/] | Fruit stalk (cm) | Seeds per fruit | Mesocarp Thickness (mm) | DH (days) | GH | Plant Height (cm) | Plant spread (Cm) | [2/] Plant shape | DD (days) | Con rate (%) | Bleach (%) | Light absorb at [3/] | Capsaicin mg/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V24 | Xian /Ch258 | 143.0 | 36.4 | 70.9 | 2.7 | 6.9 | 1.4 | 5.1 | 2.3 | 84.8 | 1.2 | 103 | 3 | 54 | 46 | 0.9 | 13.0 | 25.5 | 9.4 | 2.0 | 3.0 |
| V25 | Xian /Ch258* | 83.0 | 17.7 | 26.7 | 3.5 | 8.1 | 1.0 | 8.2 | 2.5 | 70.8 | 1.3 | 86 | 3 | 46 | 42 | 0.9 | 13.5 | 21.3 | 10.0 | 2.3 | 2.3 |
| V26 | Ch260A | 23.0 | n.a | 15.8 | 2.4 | 6.6 | 1.0 | 6.0 | 1.7 | 60.2 | 1.5 | 103 | 3 | 45 | 39 | 0.9 | n.a | n.a | n.a | 2.4 | 2.4 |
| V27 | Ch260B | 3.0.0 | n.a | 4.3 | 0.7 | n.a | n.a. | n.a | n.a | n.a | 1.5 | 103 | 3 | 32 | 24 | 0.8 | n.a. | n.a | n.a | n.a | n.a |
| V28 | Ch252-C* | 266.0 | 67.8 | 187.8 | 1.8 | 5.0 | 1.0 | 5.3 | 3.2 | 58.6 | 0.9 | 103 | 7 | 78 | 69 | 0.9 | 12.5 | 25.4 | 11.1 | 2.5 | 4.1 |
| V29 | Ch252-A | 170.0 | 31.7 | 50.4 | 5.3 | 7.9 | 1.6 | 5.0 | 2.0 | 81.0 | 0.7 | 102 | 5 | 41 | 50 | 1.2 | 13.0 | 18.5 | 12.7 | 2.8 | 3.3 |
| V30 | Ch252-B | 144.0 | 38.9 | 28.9 | 4.8 | 7.6 | 1.5 | 5.3 | 3.1 | 71.6 | 0.6 | 102 | 7 | 73 | 65 | 0.9 | 13.3 | 20.0 | 10.9 | 2.5 | 4.4 |
| V31 | Sri Lanka/Ch286* | 169.0 | 36.1 | 104.5 | 3.2 | 8.3 | 1.0 | 8.2 | 2.6 | 62.0 | 0.6 | 103 | 1 | 49 | 59 | 1.2 | 11.0 | 21.3 | 9.0 | 2.3 | 3.0 |
| V32 | Ch291* | 184.0 | 43 | 52.5 | 3.5 | 6.1 | 1.3 | 4.7 | 2.8 | 99.8 | 1.5 | 77 | 1 | 60 | 68 | 1.1 | 12.0 | 23.3 | 2.2 | 2.2 | 3.2 |
| V33 | Ch256 | 266.0 | 50.9 | 53.5 | 7.5 | 6.4 | 1.6 | 4.0 | 2.4 | 80.6 | 0.9 | 104 | 1 | 43 | 53 | 1.3 | 13.8 | 19.1 | 21.5 | 2.8 | 3.0 |
| V34 | Cili akar | 246.0 | 65 | 184 | 1.6 | 8.3 | 0.7 | 12.2 | 3.4 | 50.0 | 0.8 | 104 | 1 | 58 | 72 | 1.3 | 12.4 | 26.4 | 4.4 | 2.8 | 3.1 |
| V35 | Local Japan | 54.0 | 6.8 | 19.6 | 2.8 | 4.6 | 1.7 | 2.7 | 2.2 | 106 | 0.9 | 104 | 5 | 46 | 46 | 1.0 | 11.0 | 12.5 | 9.5 | 2.6 | 2.3 |
| V36 | Hantaka/Ch281* | 202.0 | 40.5 | 64 | 3.1 | 8.0 | 1.5 | 4.6 | 5.6 | 63.2 | 0.7 | 104 | 3 | 52 | 57 | 1.1 | 10.0 | 20.0 | 19.0 | 2.6 | 2.8 |
| V37 | Ch287 | 115.0 | 39.2 | 106 | 1.0 | 3.8 | 1.8 | 3.0 | 3.8 | 49.6 | 0.8 | 97 | 3 | 55 | 58 | 1.8 | 10.3 | 25.3 | 3.6 | 2.5 | 4.1 |
| V38 | CK#IT* | 233.0 | 55.9 | 179 | 2.0 | 4.6 | 0.8 | 5.2 | 2.4 | 81.8 | 1.1 | 104 | 3 | 58 | 57 | 1.0 | 13.2 | 23.9 | 8.0 | 2.6 | 2.6 |
| V39 | Huey Sithon* | 108.0 | 32.6 | 98.9 | 1.0 | 3.7 | 0.8 | 5.1 | 2.4 | 51.2 | 1.1 | 109 | 5 | 54 | 66 | 1.2 | 13.0 | 30.0 | 2.7 | 2.6 | 3.9 |
| V40 | Kulai* | 326.0 | 53.2 | 62.1 | 8.9 | 8.9 | 1.6 | 5.5 | 3.5 | 103 | 1.9 | 104 | 7 | 58 | 50 | 0.9 | 15.0 | 16.3 | 30.7 | 2.5 | 3.0 |
| V41 | Langkap | 248.0 | 33.8 | 25.8 | 13.3 | 11.5 | 2.0 | 7.0 | 3.4 | 111 | 1.5 | 104 | 5 | 58 | 62 | 0.9 | 14.6 | 13.6 | 34.0 | 2.5 | 2.9 |
| V42 | Tanjong Minyak | 449.0 | 74.6 | 57.4 | 13.6 | 9.3 | 2.5 | 4.8 | 3.2 | 115 | 2.1 | 104 | 7 | 71 | 67 | 0.9 | 14.2 | 16.6 | 15.2 | 2.8 | 2.9 |
| V43 | Ch290(1-3-18) | 166.0 | 30.8 | 41.9 | 5.7 | 9.1 | 1.4 | 6.7 | 3.3 | 91.2 | 1.2 | 109 | 5 | 38 | 52 | 1.4 | 14.6 | 18.5 | 18.1 | 2.7 | 3.1 |
| V44 | Cabe Brebes* | 359.0 | 85.88 | 221.1 | 3.5 | 8.9 | 0.8 | 12.4 | 2.6 | 43.6 | 1.3 | 104 | 3 | 53 | 64 | 1.2 | 12.8 | 23.9 | 9.1 | 2.7 | 3.3 |
| V45 | TIT Super | 382.0 | 63.4 | 86.7 | 5.4 | 8.7 | 1.4 | 6.5 | 3.0 | 120 | 1.9 | 104 | 1 | 70 | 70 | 1.7 | 13.1 | 16.6 | 15.2 | 2.8 | 2.9 |
| V46 | MC11/Ch234-14* | 316.0 | 33 | 64.6 | 7.1 | 9.9 | 1.7 | 6.0 | 3.5 | 1022 | 1.9 | 100 | 5 | 76 | 65 | 0.9 | 15.7 | 21.1 | 4.9 | 2.7 | 2.7 |

* genotypes selected for multilocational trial ; [1/] fruit shape index @ ratio of the length to diameter taken at the middle portion of the fruit; [2/] plant shape@ plant spread/plant height.: [3/] absorb @ absorption at 485 nm; n.a @ not available -insufficient sample to carry out analysis.DD@ days taken to dry; DH @ days from transplanting to harvest; Plant shape index @ the ratio of plant spread to plant height; GH @ Growth Habit refer to Appendix 1; Con rate @ conversion rate .

Table 4.2. (Continue) /

| Code | Varieties /Accession No. | Yeild (g/plt) | Dry Yield (g/plt) | No.fruit per plant | Mean fruit wt | Fruit length (cm) | Fruit Width (cm) | Fruit shape index [1] | Fruit stalk (cm) | Seeds per fruit | Mesocarp Thickness (mm) | DH (days) | GH | Plant height (cm) | Plant spread (cm) | [2] Plant shape | DD (days) | Con rate (%) | Bleach (%) | Light [3]/ absorb at 485 nm | Capsaicin (mg/g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V47 | Ch280 | 195.0 | 32.7 | 50.9 | 7.1 | 7.6 | 0.9 | 7.6 | 2.9 | 91.4 | 1.3 | 103 | 7 | 81 | 60 | 0.74 | 14.0 | 18.7 | 4.2 | 2.7 | 3.9 |
| V48 | Ch291(1-4-18) | 445.0 | 71.2 | 65.1 | 7.5 | 9.7 | 1.8 | 5.5 | 2.9 | 115.8 | 2.2 | 99 | 5 | 49 | 57 | 1.16 | 15.6 | 16.0 | 32.7 | 2.5 | 3.2 |
| V49 | Ch252-C(1-5-15)* | 328.0 | 82.2 | 135.6 | 3.5 | 7.0 | 1.2 | 6.7 | 3.1 | 69.8 | 0.7 | 104 | 7 | 67 | 60 | 0.89 | 13.7 | 25.0 | 9.1 | 2.4 | 4.4 |
| V50 | Jatilaba | 304.0 | 49.0 | 93.5 | 6.2 | 7.7 | 1.5 | 5.0 | 2.1 | 54.4 | 1.6 | 98 | 1 | 42 | 58 | 1.38 | 11.0 | 16.1 | 35.2 | 2.7 | 2.0 |
| V51 | Ch382(MC-CH1) | 306.0 | 53.6 | 39.1 | 9.3 | 8.1 | 2.0 | 4.1 | 3.0 | 83.6 | 2.0 | 104 | 5 | 70 | 57 | 0.82 | 13.7 | 17.5 | 20.6 | 2.4 | 2.9 |
| V52 | Ch383(MC-CH2) | 231.0 | 43.8 | 57.6 | 5.5 | 8.2 | 1.4 | 6.0 | 2.7 | 66.4 | 2.0 | 104 | 3 | 67 | 59 | 0.89 | 15.8 | 18.9 | 12.4 | 2.5 | 2.4 |
| V53 | Ch384(MC-CH3) | 532.0 | 95.2 | 76.6 | 14.6 | 10 | 2.2 | 4.6 | 3.6 | 121.4 | 1.8 | 102 | 7 | 78 | 62 | 0.82 | 14.5 | 17.9 | 2.6 | 2.3 | 2.6 |
| V54 | Ch385(MC-CH4)* | 71.0 | 42.9 | 73.9 | 1.0 | 4.1 | 0.7 | 5.8 | 2.9 | 41.8 | 1.0 | 104 | 3 | 36 | 30 | 0.85 | 11.0 | 25.0 | 16.3 | 2.3 | 3.5 |
| V55 | Ch386(MC-CH5) | 96.0 | 36.6 | 76 | 2.2 | 7.6 | 0.9 | 7.6 | 2.9 | 91.4 | 1.6 | 110 | 1 | 35 | 53 | 1.54 | 13.0 | 18.7 | 4.2 | 2.7 | 3.9 |
| V56 | Ch387(MC-1110-1)* | 259.0 | 45.6 | 66 | 4.7 | 7.1 | 1.6 | 4.8 | 2.2 | 80 | 1.3 | 104 | 5 | 52 | 59 | 1.16 | 12.8 | 17.6 | 9.8 | 2.8 | 3.4 |
| V57 | Ch388(MC)* | 629.0 | 110.1 | 75.4 | 12.1 | 10.5 | 2.3 | 4.6 | 3.2 | 118.6 | 2.0 | 104 | 5 | 70 | 62 | 0.90 | 14.8 | 17.5 | 2.7 | 2.8 | 4.1 |
| V58 | Ch389(MC)* | 474.0 | 81.1 | 64.8 | 10.7 | 8.8 | 2.0 | 4.6 | 3.7 | 96.9 | 2.0 | 104 | 7 | 63 | 56 | 0.89 | 14.6 | 17.1 | 15.5 | 2.7 | 3.6 |
| V59 | Ch391(MC) | 330.0 | 59.4 | 58 | 11.9 | 9.8 | 1.9 | 5.4 | 3.5 | 134.4 | 2.0 | 104 | 5 | 64 | 62 | 0.97 | 13.8 | 16.2 | 20.9 | 2.4 | 3.5 |
| V60 | Ch392(MC) | 309.0 | 52.2 | 41.5 | 10.5 | 9.4 | 2.2 | 4.3 | 3.1 | 105.2 | 1.9 | 104 | 7 | 57 | 59 | 1.02 | 14.0 | 16.9 | 22.4 | 2.5 | 2.6 |
| V61 | Ch393(MC)* | 501.0 | 89.7 | 78.1 | 7.6 | 7.9 | 1.9 | 4.2 | 3.2 | 98.8 | 2.1 | 104 | 3 | 61 | 59 | 0.97 | 14.6 | 17.9 | 13.0 | 2.9 | 3.1 |
| V62 | Cili40-1 | 365.0 | 65.7 | 61.5 | 8.7 | 7.7 | 1.7 | 4.7 | 2.5 | 79.6 | 2.1 | 104 | 5 | 52 | 54 | 1.01 | 15.6 | 18.0 | 23.0 | 2.5 | 3.1 |
| V63 | MC4* | 550.0 | 109.2 | 94.6 | 8.5 | 7.8 | 2.0 | 4.0 | 3.0 | 86.8 | 2.0 | 79 | 5 | 73 | 72 | 1.00 | 14.4 | 17.2 | 46.3 | 2.2 | 2.7 |
| V64 | Indian Sanam* | 347.0 | 56.6 | 40.3 | 8.6 | 9.7 | 2.1 | 4.8 | 2.8 | 113.6 | 1.8 | 89 | 7 | 74 | 58 | 0.79 | 14.0 | 16.3 | 18.2 | 2.5 | 2.8 |
| SD | - | 140.6 | 22.3 | 41.5 | 3.7 | 1.8 | 0.46 | 1.7 | 0.61 | 24.0 | 0.5 | 7.8 | NP | 12.4 | 9.8 | 0.21 | 1.6 | 3.76 | 11.3 | 0.2 | 0.6 |
| $LSD_{0.05}$ | - | 252.10 | 48.88 | 152.9 | 5.09 | 2.15 | 0.64 | 2.02 | 1.04 | 34.45 | 0.2 | 10.8 | NP | 12.63 | 13.65 | 0.19 | 0.31 | 5.24 | 0.2 | 2.14 | 1.32 |
| $LSD_{0.01}$ | - | 331.3 | 64.24 | 201.0 | 6.69 | 2.82 | 0.83 | 2.66 | 1.36 | 45.29 | 0.3 | 14.3 | NP | 16.6 | 17.93 | 0.26 | 0.41 | 6.89 | 0.26 | 2.81 | 1.72 |

* genotypes selected for multilocational trial ; [1]/ fruit shape index @ ratio of the length to diameter taken at the middle portion of the fruit; 2/ plant shape@ plant spread/plant height.; [3]/
Plant shape index @ the ratio of plant spread to plant height; n.a @ not available - insufficient sample to carry out analysis. DD@ days taken to dry; DH @ days from transplanting to harvest;
GH@ growth habit refer to Appendix 1; Con rate @ conversion rate.

#### 4.1.3. *Correlation study*

Correlation coefficient establishes the extent of association between characters. This may form additional criteria for selection. The significant of this study is to detect association of the characters, which are highly affected by environment, might have with those of higher heritability values. If the presence of association is detected, indirect selection may be practised for improving the less heritable traits.

The summary of linear correlation is shown in Table 4.3 As expected there existed high positive correlation between fresh yield and dry yield (r=0.76). Yield showed highly significant positive correlation with fruit characters such as mean fruit weight (r=0.65), number of fruits/plant (r=0.27), fruit width (r=0.57), fruit length(r=0.53), mesocarp thickness(r=0.55), seed number per fruit(r=0.44) and petiole length(r=0.41). Similar association between yield and fruit characters was observed by Nandpuri *et al* (1970), and Gomez-Guillamon and Cuartero (1986). Yield also exhibited strong positive correlation with plant height (r=0.58), canopy spread (r=0.50), and plant growth habit. Hwang and Lee (1978); Ramakumar *et al.* (1981); Gomez-Guillamon and Cuartero (1986) had reported similar high positive relationship between yield and plant height. The positive associations between yield and fruit characters suggest that these characters were important yield components and effective improvement in yield could be achieved through selection based on these components. A similar suggestion was made by Ahmed *et al.* (1997).

With days to dry and percentage of bleaching, yield showed positive correlation, an association which is undesirable. Thus, selection aimed at fewer days to dry and low percentage of bleaching may be at the expense of yield. There existed some significant positive association between yield and light absorption possibly *via* positive association of fruit length and fruit width with colour absorption. There was no obvious association between yield and capsaicin suggesting that yield and capsaicin level is independent of each other. With conversion rate, yield showed negative correlation suggesting that yield and conversion rate may not be improved simultaneously. A weak negative correlation observed between days to harvest (maturity) and yield suggests any selection aimed at early maturity might not be useful in improving yield (Ahmed *et al.* 1997).

With regards to dry yield, a stronger positive association was observed with fruit number per plant (r=0.40) than with mean fruit weight(r=0.34) and the reverse was true with fresh yield. Similar to fresh yield, positive associations but with lower magnitude were observed between dry yield and fruit characters namely fruit width, petiole length and mesocarp thickness. Thus, improving any of these fruit characters favours dry yield. Similarly, dry yield also showed positive correlation with plant height(r=0.38) and canopy spread (r=0.36). It appeared that taller and/or wider canopy spread favour fruit number which in turn led to increase in dry yield.

Regarding fruit characters, very significant positive correlation between fruit number and conversion rate was observed. With other fruit characters: fruit width, mean fruit weight and fruit length, fruit number exhibited significant but negative association. However, fruit number showed positive association with fruit shape index (ratio of length over width of fruit). The negative relationship between fruit number and other fruit characters indicates the slimmer or the smaller the size of the fruits the greater is fruit number per plant. Similar association between fruit number and mean fruit weight was also reported by Gomez-Guillamon and Cuartero (1986), Hwang and Lee (1978) and Nandpuri *et al.* (1970). Negative correlation between fruit number and mesocarp thickness (r= -0.28) and days to dry (r=-0.28) which in turn were highly correlated with each other indicates desirable associations. The more fruits produced the thinner is the flesh which, in turn is able to dry easily. Thus, selection for fruit number may result in reduction of mesocarp thickness and the number of days taken to dry simultaneously. At the same time selection, for fruit number favours conversion rate. As expected fruit number showed significant positive correlation with canopy spread (r=0.40) and plant height (r = 0.20) indicating taller plant and wider canopy favours fruit number and consequently yield. Similar results were obtained by Gomez-Guillamon and Cuartero (1986).

Mean fruit weight had shown high positive association with yield but unlike yield it had negative association with fruit number. Like yield (fresh), mean fruit weight was highly correlated to other fruit characters namely width (r = 0.80) and fruit length (r = 0.74), fruit shape (r=0.26), petiole length (r=0.53), number of seeds/fruit (r=0.61) and mesocarp thickness (r=0.57). The high negative association between means fruit weight and conversion rates indicated the high mean fruit weight did not always reflect high conversion rate. The heavy succulent fruits, which usually are high in water content, frequently have low conversion rates. Mean fruit weight also showed positive association with plant height (r = 0.49), canopy spread (r = 0.28) and plant shape (r = -0.30). Positive association with days to dry (r = 0.48) and percentage of bleaching (r=0.39) indicated tendency for bigger fruits to take longer time to dry and consequently showed higher discolouration. Some negative association was observed between mean fruit weight and capsaicin content (r = -0.19). Similar finding was reported by Chew (1984).

Days to harvest showed no significant association with any of the characters evaluated. Plant height, canopy spread showed strong positive correlation with each other and with yield possibly through positive associations characters such fruit number, mean fruit weight, fruit length. Increase in plant height or canopy spread would automatically favours yield. It is interesting to see that growth habit also showed some influence on yield *via* yield components.

Ease of drying (reflected by days to dry) was strongly associated with mean fruit weight (r=0.48), fruit length (r=0.47), fruit width (r=0.42) and seeds/fruit (r=0.47). This indicates the heavier, longer and bigger fruit containing lots of seeds takes longer time to dry and the reverse is true. Days to dry also showed strong correlation with mesocarp thickness (r = 0.70) implying thicker mesocarp usually takes longer time to dry. Selection for thinner mesocarp automatically reduces number of days to dry and both characters can be selected simultaneously. Days to dry also showed negative association with conversion rate (r=-0.34), implying that improvement of one is at the expense of the other.

Negative association between conversion rate and yield could be through negative associations with mean fruit weight, fruit length (r= -0.54) and fruit width (r = -0.68). It is interesting to see that conversion rate showed significant negative correlation with bleaching (r= -0.48). The positive association between conversion rate and capsaicin (r=0.37) together with negative correlation between capsaicin and percentage of bleaching (r= -0.48) and capsaicin and mesocarp thickness suggest that selection for capsaicin, high conversion rate, good colour retention (low bleaching) and thin mesocarp can be done simultaneously. Pungency also showed negative association with fruit characters such as fruit width, fruit length and mean fruit weight, suggesting slimmer or small chilli was more pungent.

Since the above associations in Table 4.3, were computed from data obtained from single location, therefore, the influence of environmental effect was absent. It would be interesting to see how far these results could be extended to those results of the multilocational trial.

Table 4. 3 Simple correlation coefficients among various chilli characteristics measured in the preliminary evaluation trial

| Characters | Yd | Dy | FN | Fwt | FL | FW | FR | PL | S/F | MT | DH | GH | HT | PS | SI | DD | CR | PB | CA | CAP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yield/plant (Yd) | 1 | | | | | | | | | | | | | | | | | | | |
| Dry yield (Dy) | 0.76** | 1 | | | | | | | | | | | | | | | | | | |
| Fruit no/plant(FN) | 0.27* | 0.40** | 1 | | | | | | | | | | | | | | | | | |
| Mean fruit wt (Fwt) | 0.65** | 0.34** | -0.31* | 1 | | | | | | | | | | | | | | | | |
| Fruit length(FL) | 0.53** | 0.22 | -0.24 | 0.74** | 1 | | | | | | | | | | | | | | | |
| Fruit width (FW) | 0.57** | 0.27* | -0.47** | 0.80** | 0.57** | 1 | | | | | | | | | | | | | | |
| Fruit shape | -0.08 | 0.04 | 0.50** | 0.26* | 0.24 | -0.56** | 1 | | | | | | | | | | | | | |
| Petiole length | 0.41** | 0.26* | 0.05 | 0.53** | 0.39** | 0.37** | -0.03 | 1 | | | | | | | | | | | | |
| No. Seeds/fruit | 0.44** | 0.11 | -0.35** | 0.61** | 0.47** | 0.56** | -0.29* | 0.12 | 1 | | | | | | | | | | | |
| Mesocarp Thickness (MT) | 0.55** | 0.35** | -0.28* | 0.57** | 0.52** | 0.59** | -0.24 | 0.07 | 0.59 | 1 | | | | | | | | | | |
| Days to harvest (DH) | -0.14 | -0.03 | -0.04 | 0.05 | 0.07 | -0.1 | 0.18 | 0.13 | -0.03 | -0.12 | 1 | | | | | | | | | |
| Growth habit (GH) | 0.35** | 0.15 | -0.1 | 0.43** | 0.16 | 0.39** | -0.26* | 0.25* | 0.36** | 0.24 | 0.10 | 1 | | | | | | | | |
| Plant height (HT) | 0.58** | 0.35** | 0.14 | 0.49** | 0.34** | 0.38** | -0.08 | 0.44** | 0.38** | 0.29* | 0.01 | 0.50** | 1 | | | | | | | |
| Plant spread (PS) | 0.50** | -0.36 | 0.40** | 0.28* | 0.31* | 0.18 | 0.16 | 0.29* | 0.16 | 0.1 | -0.19 | 0.01 | 0.64** | 1 | | | | | | |
| Shape index(SI) | -0.13 | -0.08 | 0.21 | -0.30* | -0.09 | -0.28 | 0.24 | -0.23 | -0.18 | -0.2 | -0.14 | -0.64** | -0.45** | 0.29* | 1 | | | | | |
| Days to dry(DD) | 0.39** | 0.1 | -0.28* | 0.48** | 0.47** | 0.42** | -0.11 | -0.01 | 0.47** | 0.70** | -0.04 | 0.28* | 0.33** | 0.12 | -0.29* | 1 | | | | |
| Conversion rate (CR) | -0.35* | 0.06 | 0.60** | -0.65** | -0.54** | -0.68** | 0.35** | -0.11 | -0.63** | -0.55** | -0.05 | -0.18 | -0.12 | 0.03 | 0.08 | -0.34** | 1 | | | |
| % Bleach (PB) | 0.37** | 0.18 | -0.19 | 0.39** | 0.27* | 0.37** | -0.18 | 0.15 | 0.07 | 0.33* | -0.1 | 0.08 | -0.02 | -0.06 | -0.08 | 0.13 | -0.48** | 1 | | |
| Light abs. at 485 (CA) | 0.30* | 0.09 | 0.07 | 0.19 | 0.26* | 0.24 | 0.03 | 0.15 | 0.12 | 0.16 | 0.24 | 0.08 | 0.07 | 0.16 | 0.15 | 0.15 | -0.26* | -0.03 | 1 | |
| Capsaicin(Cap) | -0.04 | 0.04 | 0.24 | -0.19 | -0.23 | -0.24 | -0.05 | 0.17 | -0.1 | -0.32 | 0.1 | 0.20 | 0.16 | 0.07 | -0.11 | -0.11 | 0.37** | -0.48** | -0.02 | 1 |

*, **, @ Significant at 0.05, 0.01, respectively; 1/ fruit shape index ratio of the length to diameter taken at the middle portion of the fruit. Shape index @ the ratio of plant spread to plant height

## 4.2 Multi-location trials

### *4.2.1 Characteristics of the environment*

The summary of planting dates, soil types, effective rainfall for each of the test environments during the growing seasons is given in Table 4.4. The details of the air temperature, the relative humidity (RH), evaporation rate, solar radiation, sun shine and the rainfall distribution during the crop cycle is given in Appendix 1I. Rainfall of less than 100 mm/month or 30 mm/decade is considered dry. While a monthly rainfall of greater than 200 mm or 70 mm/decade is considered wet, and very wet when monthly rainfall of more than 250 mm. Based on this classification, Cameron Highlands second planting-season (CH2) experienced very wet conditions, while Cameron Highlands first planting-season (CH1) and Japan Kebab second planting-season (JK2) were also during considerably wet. Both crops in Kundang and Telong were also grown during considerably wet period. Bertam first planting- season (BM1) on the other hand, was during dry period.

Table 4.4. The air temperature (°C), the relative humidity, evaporation rate, solar radiation, sunshine and the rainfall distribution during the crop cycle

| LOCATION | DURATION | AIR TEMPERATURE (°C) Monthly Max | Monthly Min | Monthly Avg | Absolute High | Absolute Low | R.H. monthly mean (%) | EVP mm/day | Sol [1/] $mjk^{-2}$ | Shine hrs per day | Rainfall mm / month |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | 03/91-09/91 | 35.7 | 23.3 | 29.5 | 42.2 | 21.0 | 78.0 | 3.6 | 16.1 | 4.8 | 154.5 |
| JK2 | 09/92-03/93 | 32.9 | 22.4 | 27.6 | 35.1 | 20.0 | 80.0 | 3.4 | 15.7 | 5.6 | 200.8 |
| CH1 | 02/92-12/92 | 22.8 | 15.2 | 18.3 | 25.8 | 13.5 | 85.0 | 2.0 | 12.6 | 4.7 | 204.0 |
| CH2 | 07/93-01/94 | 22.1 | 15.2 | 17.4 | 24.8 | 15.7 | 93.0 | 1.9 | 14.5 | 4.3 | 270.0 |
| KD1 | 12/93-05/94 | 32.8 | 22.5 | 27.6 | 35.5 | 19.7 | 71.0 | 4.0 | 14.3 | 5.5 | 218.0 |
| KD2 | 09/94-02/95 | 32.4 | 22.5 | 27.4 | 35.9 | 20.4 | 81.0 | 4.0 | 14.3 | 4.9 | 222.0 |
| LG1 | 10/91-04/92 | 31.2 | 22.7 | 26.9 | 33.8 | 21.2 | 81.0 | 3.4 | 15.7 | 5.9 | 137.2 |
| LG2 | 05/93-12/93 | 31.3 | 24.0 | 27.7 | 34.5 | 21.9 | 85.0 | 2.8 | 18.5 | 5.2 | 164.0 |
| BM1 | 10/91-04/92 | 32.9 | 23.1 | 28.0 | 36.0 | 20.0 | 77.0 | 5.3 | 19.4 | 7.2 | 99.0 |
| BM2 | 02/93-08/93 | 33.1 | 23.5 | 28.3 | 35.8 | 20.1 | 74 .0 | 4.4 | 18.7 | 7.4 | 127.8 |
| GM1 | 05/92-9/92 | 32.5 | 23.4 | 27.9 | 36.8 | 20.7 | 81.0 | 3.9 | 13.2 | 6.8 | 170.4 |
| GM2 | 08/93-12/93 | 31.5 | 23.0 | 27.1 | 33.8 | 21.1 | 75.0 | 3.0 | 17.1 | 6.2 | 163.2 |
| TL1 | 08/91-12/91 | 30.7 | 23.7 | 26.7 | 34.0 | 21.9 | 83.0 | 3.8 | 16.1 | 4.9 | 229.7 |
| TL2 | 07/92-11/92 | 31.6 | 23.6 | 27.0 | 34.8 | 20.9 | 79 .0 | 4.2 | 16.9 | 6.1 | 206.7 |

1/@ Solar radiation; R.H@Relative humidity; EVP@ evapotranspiration rate (mm/day); Shine @ number of hours of sun shine per day; JK1 @Jalan Kebun 1st planting-season; JK2 @Jalan Kebun 2nd planting-season; CH1 @ Cameron Highlands 1st planting-season: CH2@ Cameron Highlands 2nd planting -season: KD1 @Kundang 1st planting- season; KD2@Kundang 2ndplanting-season; LG1@ Linggi 1st planting-season; LG2@ Linggi 2nd planting-season; BM1@ Bertam 1st planting-season; BM2@Bertam 2nd planting-season; GM1@Gajah Mati 1st planting-season; GM2@Gajah Mati1 2nd planting-season; TL1@ Telong 1st planting- season; TL2@ Telong 2nd planting- season.

### *4. 2.2 Drying Method*

A simple in - field study was conducted to determine maturity stage for harvesting chilli for drying and drying method to provide some information on the suitability of the solar dryer used.

Appendix 11 shows the temperatures inside the dryer against the surrounding. The modified solar dryer used is illustrated in Plate 1. A brief description of how the solar dryer was constructed was described in Material and Methods. During the shinny day, the temperature inside the dryer rose rapidly after 1100 hours and reached the acceptable drying temperature of 40 °C (Samsudin *et al.* 1992) around noon. The hottest temperature recorded was 44 °C which generally lasted until 1600 hours. Appendix II shows the day temperature pattern under the solar dryer at minimum (0800 hr) and maximum (1400 hr) times over a period of 18 days

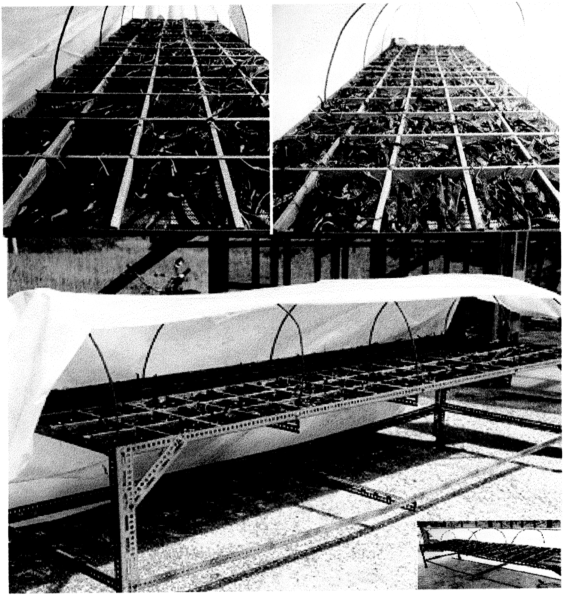


Plate 1. Modified conventional dryer
Left: Fresh chilli placed on plastic insulated wire netting ready to be dried.
Right: Solar dried chilli still inside the dryer.
Bottom: Modified solar dryer on concrete floor: Frame made from iron angled with plastic insulated wire netting (mesh size 1cm sq) as base. Detachable cover made from UV treated plastic (see Inset).

### *4.2.3 Performance of the G x E trials*

4.2.3.1 ANOVA by environment

Analysis of variance for yield/plant, number of fruit/plant, mean fruit weight, dry yield/plant, plant height, days to harvest, days to dry, dry weight, conversion rate, % of bleaching, light transmission and capsaicin content in each of the 14 environments was shown in Tables 4.5 - 4.7. Fresh yield and yield components and other agronomic characters showed significant variation for genotype effects in all environments indicating sufficient varietal variation for effective selection. However, for some characters, non-significant genotypic effects were detected in some trials, such characters were dry yield/plant (Table 4.5), days to dry (Table 4.6) and all the quality characters namely percentage of bleaching, colour and capsaicin (Table 4.7).

Table 4.5. Mean Squares for yield/plant, No. of fruits/plant, mean of fruit weight and dry yield of 22 genotypes for each of the 14 environments

| Traits | Source (df) | JK1 x 10000 | JK2 x 10000 | BM1 x10000 | BM2 x 10000 | GM1 x 10000 | GM2 x 10000 | CH1 x 10000 | CH2 x 10000 | LG1 x 10000 | LG2 x 10000 | TL1 x 10000 | TL2 x 10000 | KD1 x 10000 | KD2 x 10000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ENVIRONMENTS | | | | | | | | | | | | | |
| | | Mean Squares | | | | | | | | | | | | | |
| Fresh yield (g/plant) | x 10000 | | | | | | | | | | | | | | |
| | Genotype(21 | 410.70** | 428.47** | 251.94** | 131.53** | 821.57** | 185.74** | 3723..40 | 5142.19* | 349.94** | 89.51*** | 383.09** | 795.58** | 573.92** | 202.58** |
| | Replicate (3) | 255.09NS | 595.26** | 658.15NS | 3168.56 | 280.02N | 401.79N | 3882.63 | 367.71N | 154.86N | 1851.07 | 2191.37 | 1239.77 | 2054.25 | 22.64NS |
| | Error (63) | 70.62 | 209.82 | 96.39 | 386.8743 | 121.77 | 35.99 | 623.05 | 137.35 | 73.8 | 134.22 | 145.13 | 380.21 | 407.32 | 13.65 |
| No. of fruits/plant | x 10000 | | | | | | | | | | | | | | |
| | Genotype | 231.35** | 216.77** | 64.27*** | 745.49** | 241.70** | 216.99** | 170.03** | 17.03 *** | 234.29** | 81.17*** | 131.85** | 78.91*** | 125.03** | 4.66*** |
| | Replicate (3) | 77.88* | 47.26NS | 71.51NS | 1555.51* | 106.18N | 43.11*** | 119.88** | 4.41 NS | 70.17 ** | 38.14NS | 98.53 ** | 78.09* | 0.009 NS | .75 NS |
| | Error (63) | 24.75 | 87.58 | 15.49 | 46.25 | 91.31 | 2.67 | 27.35 | 3.13 | 37.65 | 17.34 | 20.34 | 26.391 | 37.022 | .73 |
| Mean fruit weight (g) | | | | | | | | | | | | | | | |
| | Genotype | 8.22*** | 4.04*** | 15.59*** | 10.86*** | 20.12*** | 18.08*** | 62.51*** | 48.83*** | 8.14*** | 12.31*** | 22.77*** | 24.98*** | 26.22*** | 17.28*** |
| | Replicate (3) | 0.64 NS | 2.26 NS | 0.87 NS | 1.93 NS | 2.54 NS | 1.37 NS | 12.27* | 8.48 NS | 1.33 NS | 16.55*** | 5.58 NS | 0.06 NS | 9.09** | 0.07 NS |
| | Error (63) | 0.69 | 0.55 | 0.76 | 0.73 | 1..35 | 2.53 | 3.84 | 4.34 | 0.72 | 1.24 | 2.17 | 1.19 | 2.03 | 0.47 |
| Dry yield (g/plant) | x 100 | | | | | | | | | | | | | | |
| | Genotype | 11.95*** | 9.92NS | 6.00NS | 1031.49* | 3.06NS | 3.80* | 86.56*** | 19.60* | 195.0.9* | 39.42NS | 90.5.9*** | 14.99NS | 100.72N | 42.0.2*** |
| | Replicate (3) | 691.7* | 1589NS | 3090.2** | 25305.9* | 26.62*** | 184.3.3* | 139.57** | 131.3.9N | 62.43NS | 68.80*** | 41.38*** | 70.37* | 36.95** | 0.57 NS |
| | Error (63) | 2.42 | 7.61 | 3.973 | 267.7.9 | 7.29 | 2.14 | 17.63 | 9.84 | 4.29 | 5.17 | 3.09 | 2051.4 | 7.77 | 0.61 |

NS @Not significant at P > 5% (0.5): *, **, *** @Significant at P ≤ 5% (0.05), 1% (0.01) 0.1% (0.001).
JK1 @ Jalan Kebun (planting-season 1); BM1@Bertam (planting-season 1); GM1 @ Gajah Mati (planting-season 1); CH1 @ Cameron Highlands (planting-season 1); LG1 @Kuala Linggi (planting-season 1);
TL1 @Telong ( planting-season 1); KD1@Kundang (planting-season 1); JK2 @Jalan Kebun (planting-season 2); BM2 @ Bertam (planting-season 2); GM2 @ Gajah Mati (planting-season 2) ;
CH2 @ Cameron Highlands (planting-season 2); LG2 @ KualaLinggi (planting-season 2); TL2 @Telong (planting-season 2); KD2 @Kundang (planting-season 2).

Table 4.6. Mean Squares for days to harvest, days to dry , dry weight, conversion rate and plant height of 22 genotypes for each of the 14 environments

| | | ENVIRONMENTS | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean Squares | | | | | | | | | | | | | |
| Traits | Source df | JK1 | JK2 | BM1 | BM2 | GM1 | GM2 | CH1 | CH2 | LG1 | LG2 | TL1 | TL2 | KD1 | KD2 |
| Days to harvest | Genotype (21) | 264.15*** | 23.25*** | 118.29*** | 170.52*** | 214.30*** | 49.89*** | 472.59*** | 345.46*** | 113.56*** | 236.72*** | 48.83*** | 54.06*** | 270.16*** | 282.91*** |
| | Rep (3) | 0.01NS | 0.01NS | 0.01NS | 0.21NS | 1.67NS | 4.47 NS | 0.18NS | 0.01NS | 0.50NS | 0.03NS | 0.18NS | 0.18 | 0.03 NS | 0.07NS |
| | Error (63) | 0.01 | 0.01 | 0.01 | 0.14 | 2.41 | 2.52 | 0.18 | 0.03 | 1.46 | 0.03 | 0.18 | 0.18 | 0.04 | 0.06 |
| Days to dry | Genotype (21) | 3.38** | 9.39*** | 5.72 NS | 3.19* | 5.27 NS | 9.92* | 19.17 NS | 5.68 NS | 28.50*** | 23.09** | 29.86 NS | 12.53* | 8.49*** | 22.43*** |
| | Rep (3) | 4.62* | 73.53 NS | 0.79** | 24.74*** | 13.14* | 29.04** | 22.94 NS | 2.13 NS | 3.30 NS | 37.41* | 226.01*** | 38.41** | 0.14 NS | 1.17 NS |
| | Error (63) | 1.44 | 12.19 | 1.13 | 1.54 | 3.39 | 4.77 | 23.15 | 3.91 | 9.15 | 9.25 | 33.14 | 6.37 | 2.87 | 2.81 |
| Dry weight x10 (g) | Genotype(21) | 44.3*** | 18.0*** | 35.6*** | 23.5*** | 43.3*** | 17..2** | 12.7* | 22.3** | 33.5** | 15.1*** | 12.4** | 29.5*** | 10..5** | 47..7* |
| | Rep (3) | 16.71 NS | 31.22 | 73.18 | 196.65*** | 230.68N | 8.10 | 59.31 | 85.39 | 35.49 | 41.79 NS | 21.65 | 119.08 | 88.84 | 4.42 |
| | Error (63) | 72.16 | 53.41 | 69.57 | 28.05 | 50.76 | 39.93 | 18.63 | 97.53 | 33.28 | 37.67 | 19.01 | 76.43 | 30.78 | 51.06 |
| Conversion rate | Genotype | 97.52*** | 45.03* | 88.99* | 58.86*** | 108.11** | 43.08* | 31.64 | 55.78* | 83.36** | 37.80*** | 31.00* | 73.81* | 26.31* | 116.9 |
| | Rep (3) | 2.76 NS | 7.79 | 18.58 | 49.55*** | 57.49 | 2.03 | 14.79 | 21.36 | 8.89 NS | 10.40 NS | 5.42 | 28.74 | 22.76 | 1.10 |
| | Error (63) | 17 | 13.35 | 17.42 | 7.01 | 12.67 | 9.98 | 4.65 | 24.37 | 8.3 | 9.44 | 4.75 | 19.11 | 7.66 | 12.76 |

| Plant height (cm) | | JK1 | JK2 | GM1 | GM2 | CH2 | LG2 | KD1 | KD2 |
|---|---|---|---|---|---|---|---|---|---|
| | Genotype | 411.37*** | 675.36*** | 664.85*** | 524.04 | 230.35*** | 260.04** | 714.57*** | 493.4 |
| | Rep (3) | 210.07** | 1082.6*** | 188.92NS | 46.86 | 512.85*** | 130.4 | 479.12** | 209.8 |
| | Error (63) | 49.24 | 94.27 | 88.94 | 28.96 | 31.84 | 72.28 | 99.29 | 43.06 |

NS @Not significant at P > 5% (0.5): *, **, *** @Significant at P ≤ 5% (0.05), 1% (0.01) 0.1% (0.001).
JK1 @ Jalan Kebun (planting-season 1); BM1@Bertam (planting-season 1); GM1 @ Gajah Mati (planting-season 1); CH1 @ Cameron Highlands (planting-season 1); LG1 @Kuala Linggi (planting-season 1);
TL1 @Telong ( planting-season1); KD1@Kundang (planting-season 1); JK2 @Jalan Kebun (planting-season 2); BM2 @ Bertam (planting-season 2); GM2 @ Gajah Mati (planting-season 2);
CH2 @ Cameron Highlands (planting-season 2); LG2 @ KualaLinggi (planting-season 2); TL2 @Telong (planting-season 2); KD2 @Kundang (planting-season 2).

Table 4.7. Mean Squares for % of bleaching, light transmission and capsaicin content of 22 genotypes for each of the 14 environments

| | | ENVIRONMENTS | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean Squares | | | | | | | | | | | | | |
| | Source of variance | JK1 | JK2 | BM1 | BM2 | GM1 | GM2 | CH1 | CH2 | LG1 | LG2 | TL1 | TL2 | KD1 | KD2 |
| % of bleaching | Genotype(21) | 564.92*** | 429.57NS | 829.19*** | 228.22** | 589.93* | 445.62*** | 726.18*** | 1281.4*** | 640.42*** | 1013.1*** | 495.99* | 1317.48** | 822.84*** | 653.23*** |
| | Rep(3) | 225.36NS | 984.16* | 235.34NS | 167.26*** | 468.99NS | 1682.03 | 448.09NS | 800.35* | 757.05*** | 349.27NS | 2353.6*** | 1105.5NS | 2140N | 409.81NS |
| | Error (63) | 150.78 | 261.05 | 88.84 | 87.26 | 286.44 | 136.9 | 196.92 | 282.91 | 121.69 | 304.79 | 237.72 | 552.56 | 216.45 | 151.00 |
| Light transmission at 490 nm (%) | Genotype(21) | 43.80*** | 32.49*** | 97.23*** | 67.72*** | 27.35*** | 29.57*** | 21.49** | 30.64*** | 33.61** | 38.07*** | 13.24 NS | 27.16*** | 19.50*** | 13.83*** |
| | Rep(3) | 9.19 NS | 40.66** | 3.64 NS | 3.37 NS | 1.00 NS | 1.62* | 57.96** | 10.99 NS | 898.83*** | 4.20 NS | 31.65 NS | 11.65 NS | 1.52* | 3.96 NS |
| | Error(63) | 9.65 | 8.15 | 8.98 | 2.26 | 6.07 | 0.58 | 9.52 | 7.93 | 14.55 | 4.11 | 11.72 | 8.77 | 2.73 | 4.13 |
| Capsaicin content (mg/g) | Genotype (21) | 9.07*** | 9.76** | 37.46*** | 11.69*** | 7.20*** | 15.32*** | 4.22** | 5.56** | 5.04** | 6.98*** | 5.55*** | 5.91*** | 5.84 NS | 10.05*** |
| | Rep(3) | 1.05 NS | 4.43 NS | 31.13 NS | 2.92 NS | 3.27 NS | 9.59 NS | 5.69 NS | 1.58 NS | 23.56 NS | 0.62 NS | 5.65 NS | 2.47 NS | 9.72 NS | 4.36 NS |
| | Error(63) | 2.34 | 3.38 | 32.38 | 5.88 | 2.07 | 4.493 | 1.82 | 2.61 | 2.73 | 2.03 | 5.35 | 2.04 | 4.41 | 1.93 |

NS @Not significant at $P > 5\%$ (0.5): *, **, *** @Significant at $P \leq 5\%$ (0.05), 1% (0.01) 0.1% (0.001).
JK1 @ Jalan Kebun (planting-season 1); BM1@Bertam (planting-season 1); GM1 @ Gajah Mati (planting-season 1); CH1 @ Cameron Highlands (planting-season 1); LG1 @Kuala Linggi (planting-season 1); TL1 @Telong ( planting-season 1); KD1@Kundang (planting-season 1); JK2 @Jalan Kebun (planting-season 2); BM2 @ Bertam (planting-season 2); GM2 @ Gajah Mati (planting-season 2); CH2 @ Cameron Highlands (planting-season 2); LG2 @ KualaLinggi (planting-season 2); TL2 @Telong (planting-season 2); KD2 @Kundang (planting-season 2).

4.2.3.2. Mean performance of genotype and environments

The genotype performance with their coefficients of variation (CV) in each environment for each of the 12 characters were presented in descending order with the most favourable location placed in the extreme left. The mean values demonstrate substantial variation among varieties at each environment (Tables 4.8 - 4.19).

For convenience, characters were separated into three groups *viz* a) yield and yield components b) agronomic characters and c) quality characters.

a) Yield and yield components.

For yield, coefficient of variance (CVs) among the genotypes within environment varied from 21.6-74.0 % (Table 4.8). The average yield for each genotype across the environments varied from 227.9 g/plant to 446.3 g/plant with local checks, MC11 recorded yield of 400 g/plant while Kulai recorded 388g/plant. Although there were 7 varieties namely MC4, Ch393, Ch388, Ch389, Ch291, Cabe Brebes and Ch284-6 which yielded more than 400 g/plant all showed great variation across environment. The two Japanese varieties, Ch385 (V54) and Variety Hantaka (Ch281), though appeared to produce the lowest yield of less than 250 g/plant, they showed potential to record higher yield per unit area should planting density be increased.

Similarly, environmental performance varied greatly. The general trend showed mineral soil environments namely Cameron Highlands, Bertam, Gajah Mati and Telong recorded relatively higher yields than other soil environments such as peat, acid sulphate or tin tailing. The highest yielding environment is 1139.2 g/plant recorded in Cameron Highlands first crop (CH1), followed by BM2 and TL2. The poorest environment is KD2 at 95.2 g/plant. It is interesting to note that

MC4 and Ch257 (V25) showed same ranking position of first and third, respectively, in Cameron Highlands in both planting-seasons.

Of the mineral environment, Cameron Highlands recorded the highest yield, probably due to the additional effect of the cooler temperature (15-23 °C) in Cameron Highlands relative to other locations. A drop in yield of the second crop in Cameron Highlands coincided with the heavy rainfall of 270 mm/month during the crop cycle (Table 4.4). The high rainfall resulted in high incident of flower abortion, which, in turn resulted in lower fruit set. The high incidence of anthracnose during the rainy season contributed to further reduction in marketable yield of the second crop in Cameron Highlands. Low yield in first planting-season in Bertam coincides with very low rainfall (Table 4.4).

With regards to number of fruits/plant, high CVs among genotypes within environment ranging between 26.71-89.57% were noted (Table 4.9), with average genotypic mean ranging from 59.0 fruits/plant to 252.8 fruits/plant. The less number of fruits/plant appeared to come from the big fruit variety, indicating the variety with the highest fruit number is not the most favourable in fruit size. The seven top yielders recorded values between 74-128 fruits/plant. There was substantial variation for each genotype across environments. The highest overall value was 698.3 fruits/plant produced by Japanese Ch385 (V54) in Cameron Highlands (CH1). This was followed by 592.1 fruits/plant and 539.4 fruits/plant produced in Bertam first planting-season (BM1) by *cili padi* liked sister lines Ch252-C (V28) and Ch 252-C-P (V49), respectively. This indicates the changes in genotype ranking from one environment to another, which, in turns, indicates interaction between genotype and environment in number of fruits/plant.

Similarly, wide environmental means ranging from 23.4-254.6 fruits/plant with variations between seasons generally smaller than between locations were noted. Highest number of fruits/plant was recorded in Bertam (mineral) followed by crops in Cameron Highlands (mineral), Jalan Kebun (peat), Telong (bris), Gajah Mati (mineral), Kuala Linggi (acid sulphate) and Kundang (tin tailing) in descending order. It appears that rainfall pattern might have an influence on this trait as mean fruit number was higher when the monthly rainfall was below 200 mm compared to that when the rainfall exceeded 200 mm. Extreme rainfall could cause more flower drop and hence reduced the fruit number. Soil factors also seemed to affect fruit number. Mineral soil and well developed peat generally showed favourable effect on fruit number (Table 4.9). Combined effect of soil factor and too much rain could have reduced the fruit number in Kundang considerably.

Mean fruit weight on the other hand, showed narrow range of CVs between 16.15% - 30.72% (Table 4.10). Most of the high yielders were big fruited (>7 g). The Ch291P (V1) and Ch389 (V58) produced fruits of 7.5 g and 7.2 g, respectively. Other high yielders namely Ch388 (V57), MC11 (V46), MC4, Ch291 (V32), Ch284-6 (V15), Ch393 (V61), and Kulai (V40) produced medium size fruits (5.5-6.0) g. Varieties Ch254 (V9), Ch387 (V56), Ch257 (V25) Purple chilli and Brebes (V44) exhibited fairly small fruits of between 3.5 - 5.0 g per fruit. *Cili padi* like varieties with mean fruit weight <3.0 g/fruit include CK#IT (V38), Hantaka (V36), Ch 252-C (V28), Sri Lanka (V31), Huey Sithon (V39), India, and Ch385 (V54). The smallest mean fruit size of less than 2.0 g was exhibited by Ch 252-CP (V49). Interesting relationship existed between fruit size and number of fruits per plant, variety with the smallest fruit size like Ch252-C-P (V49) appears to show the highest fruit number per plant, while variety Ch291-P (V1) which recorded the biggest fruit size showed the least fruit number per plant. Other smaller fruit genotypes such as Ch 252-C, Huey Sithon (V39), Ch 286(V31), Bribes (V44), Ch385 (V54), India, CK#IT (V38) and medium size fruit such Purple Chilli (V16) showed considerable high fruit number of between 160-115 fruits per plants. Bigger size fruit genotypes however, exhibited between 59 - 86 fruits per plant. The ranking of genotype mean changes across the environments indicating there was possibility of interaction between genotypes and location.

Environmental performance also showed variation in mean fruit weight with obvious differences between locations but less obvious differences between crops at the same location. Comparison of environmental means demonstrates an interesting relationship between mean fruit weight and locations and agricultural drought zone. Lower temperature in Cameron Highlands exerted favourable influence on the fruit size. This followed by crops from agriculture zone 1 (Telong and Gajah Mati) which in turns were significantly bigger than those from zone 2 (Bertam and Linggi). With the exception of Jalan Kebun, the crops grown in zone 4 namely Cameron Highlands and Kundang tend to have bigger fruit size. Apparently, crops on mineral environments generally produced bigger fruits. On the other hand, the crop grown on peat and acid sulphate soils in Jalan Kebun and Kuala Linggi respectively, exhibited small fruits. The acidic soil of Kuala Linggi and Jalan Kebun could have suppressive effect on fruit size.

Dry yield, like fresh yield, recorded wide range of CVs among genotypes within environment between 22.28-82.16 % (Table 4.11). The average dry yields for check varieties namely Local Kulai, MC4 and double purpose MC11 were 63.9 g/plant, 68.7 g/plant and 69.4 g/plant respectively. Ten varieties superseded local checks, recorded dry yield of more than 70.0 g/plant. In descending order, they were Brebes(V44), Ch393 (V61), Thai Ch252-P(V49), Thai Ch252(V28), Huey Sithon(V39), Lombok(V15), Taiwan(V38), Local Ch388(V57), Sri Lankan (V31) and Purple Chilli (V16). These were the known imported dry chilli varieties. It appeared that these varieties performed differently from environment to environment resulting in environmental performance ranging from 17.96 g/plant to 188.43 g/plant. Like fresh yield, highest value was recorded in Cameron Highlands (CH1) followed by Bertam, Gajah Mati, Telong, Jalan Kebun, Kuala Linggi and Kundang.

b) Agronomic characters

Coefficients of variance (CVs) for days- to- harvest among the trials were very low ranging between 0.12 - 2.05%. Genotypic means across environments for days to harvest showed differences ranging between 68.6-93.7 (Table 4.12). Five varieties showed maturity period of less than 80 days. These were Korean Ch291 (V32), local MC4, Indonesian Lombok (V15), Japanese Hantaka (V36) and Chinese Xian (Ch257). There were three late varieties, which took more than 12 weeks to mature. They were Ch393 (V61) one of the top yielders, Huey Sithon and local Kulai which took 93.7, 90.0 and 86 days respectively, to mature. For this parameter, differences in environmental performance were striking (Table 4.12). There was a distinct difference in days to harvest recorded in Cameron Highlands (119.9 and 116.0 days, respectively) and other environments (63.9-87.7 days). Differences between seasons however, were not obvious. The relatively low temperature of Cameron Highlands could have slowed down the growth rate causing a delay in harvesting to about 17 weeks compared to 9-12 weeks in other locations in the low lands.

For plant height (Table 4.13) there were variations in genotypic means across the environments ranging between 43 - 76 cm. Seven varieties recorded acceptable height of slightly above 60 cm. These were Ch 252-C-P (V49), MC11, Ch389 (V58), Ch393 (V61), Kulai, Purple chilli and MC4. Variation in genotypic performance with environment was detected with Xian (Ch257) which varied from 48.2 to 60 cm under favourable environments. Variety Ch286 (V31) though grown to 45 cm under favourable environment was still the shortest genotype, demonstrated no change in ranking. It appeared that though most varieties showed inconsistent performance, the change in ranking of the varieties with environments was not very distinct. Plant height exhibited greater variations between locations as compared to within location. Environmental means ranging between 42 to 78 cm with the tallest crop from Gajah Mati (mineral soil) followed closely by those planted in Jalan Kebun (peat) and Cameron Highlands (mineral soil). Generally, the plants were taller in areas with sufficient rainfall ranging from 150-200 mm/month. On the other hand, shorter plants were recorded in area, which received excessive rainfall of more than 200 mm/month such as in Kundang (KD2). This is in agreement with Tan and Mak (1992) working on cassava, that extreme rainfall suppressed plant height. Shorter plant height was also recorded in Kuala Linggi, an acid sulphate area during dry spell with rainfall of only 137 mm/month. A similar negative effect on plant dimensions by either too abundant or poor water supply was reported by Gracza (1978). This variation in environmental performance is not surprising, since plant height was reportedly to have low to moderate heritability (Nandpuri *et al.* 1971; Singh and Singh 1970).

For days- to- dry, it is desirable to have variety with shorter period to dry. Small coefficients of variance, ranging between 7.77 to 36.47 % and very narrow genotypic means across environments between 14-17 days were recorded (Table 4.14). Eight varieties took 15 days or less to dry, with Indian Sanam (V64) the fastest to dry, followed by purple chilli, Ch291, Sri Lanka (V31), Brebes (V44), Ch252-C-P (V49), Ch257 (V25) and Ch252-C (V28). Local varieties Kulai, MC 4, Ch387(V56), MC 11 and Ch389(V58), each required 16 days or more to dry. There were changes in ranking of genotypes between environment indicating possible interaction between varieties and environment. Environmental means of 9.75 to 21.34 days were recorded with Bertam (in agriculture zone 2) exhibited the least number of days for fruit to dry, recording 9.7 days and 11.8 days for first and second season respectively, giving the impression that Bertam was the most favourable environment for chilli drying and hence dry chilli production. While Linggi first season (LG1) recorded 13.8 days, followed by locations in zone 1 namely, Gajah Mati and Telong, both took 2 weeks (14.6 and 14.5 days, respectively) to dry. While locations in zone 4 (where there is no distinct dry season) namely, Kundang and Jalan Kebun recorded the longest number of days to dry, average of 17 and 18 days. Variation between season appears to be greater than variation between locations. The number of days to dry appears to synchronise with temperature and rainfall pattern (Table 4.4). Location which recorded highest temperature showed the least number of days to dry and vice versa. It is also apparent that locations in the same zone showed similar trend. Soil type did not show significant effects on days taken to dry. Locations in the Northern region where there is distinct dry season seemed to be very favourable for this parameter.

Conversion rate was computed from dry weight. The coefficient of variance for conversion rate was generally low ranging from 11.46 to 24.30 % and the environmental means ranging from 12.66 to 23.10% (Table 4.15) Significant differences between genotypes were noted. All varieties recorded genotypic means of more than 15.0% except for high yielder, Ch389(V58) which showed the lowest mean conversion rate of 14.7%. Sri Lanka showed the highest conversion rate of 24.0%. Seven varieties namely Huey Sithon(23.5%), Ch252-C-P(V49), Ch 385(V54), India Sanam(V64), Ch 252-C(V28), CK#IT(V38) and Brebes(V44) recorded conversion rates of more than 20%. Others, namely Purple chilli, Hantaka and Xian (V25), Lombok (V15), MC11 (17.8), Ch393(V61), Kulai, Ch291(V32), Ch388(V57), MC4 and Ch 291-P recorded above break even conversion rate of 15%. No clear trend existed for dry weight and conversion rate across environments. No obvious changes in ranking of the genotypes implying conversion rate is not highly affected by environments.

c) Quality characters

Percentage of bleaching is a negative character. It reflects colour retention on drying. High coefficient of variance ranging between 23.8 to 70.76 % were recorded (Table 4.16). The lower the percentage of bleaching, the more desirable is the variety. The genotype with the lowest percentage of bleaching was Ch 252-C(P) (16.0%) and this was followed by varieties Huey Sithon, Ch 252-C, Ch 385, Purple Chilli, Sri Lanka, Hantaka, India, Brebes, Ch386(V56), Xian(V25), Ch 234-14(MC11), Ch388, Ch393, Ch389, Ch291, Lombok (V15), CK#IT(V38), Ch254, Kulai, MC4 and Ch291-P, the variety with the highest percentage of bleaching. Environmental environments. The hottest varietiy was Thai Ch252-C-P with capsaicin level of 9.41mg/g followed by Huey Sithon.(8.76 mg/g), Sri Lanka (V31), Ch385, Ch393, Purple Chilli, Xian (Ch257). Varieties with capsaicin of ± 7.5 mg/g (medium range) include Indian Sanam (V64), Ch252-C(V28), Brebes and Ch388(V57), Ch 291-P(V1), Hantaka, Ch254(V9), Kulai, MC4, MC11, Ch291(V32), Lombok(V15),Ch389(V58) and Ch387(V56). Significant variantion between environments also existed with environmental means ranging from 5.39 mg/g to 11.08 mg/g. On the whole, Bertam exhibited the highest mean capsaicin content followed by Gajah Mati, Kundang and Linggi. The highest environmental average of 11.1 mg/g was exhibited by second season crop grown in Bertam followed closely by capsaicin value of 10.2 mg/g. in Gajah Mati 2nd season. These coincide with low rainfall of less than 100 mm in Bertam and less than 150 mm/ month in most of the growing time in Gajah Mati. A look at Table 4.4 shows that the high capsaicin content coincides with the low rainfall received during the growing season at the respective location. It appears that locations in zone with distinct drought appears to produce more pungent chilli. Lower capsaicin contents were obtained from crops grown in Telong, Jalan Kebun and Cameron Highlands. The lowest reading on capsaicin was observed in Cameron Highlands where the temperature is relatively lower than any tested locations, indicating the suppressive effect of cold night temperature (Table 4.4) in Cameron Highlands. This is in agreement with the finding of Jeong *et al.* (1995). Ohta (1962) and Levy *et al.* (1989) also found capsaicin formation was favoured by high temperatures. The sandy nature of tin tailing created a warm environment at the root region favoured formation of capsaicin in Kundang, despite heavy rainfall. Jalan Kebun and Telong recorded among the lowest capsaicin level. The acidic nature of peat in Jalan Kebun and heavy rainfall of Telong could have suppressive effect on capsaicin formation. The higher capsaicin reading in Jalan Kebun season 1 compared to second season coincides with less rainfall received in the first season. Similarly, the less rainfall received in Kuala Linggi had resulted in higher capsaicin level despite the acidic nature of the soil. This suggests the possibility of low rainfall exerting greater effect on capsaicin formation than does the acidic nature of the soil. Regarding soil type, mineral environment appears to favour capsaicin formation while the acidic soil has suppressive effect .

Table 4.8. Mean values of yield (g/plant) for genotypes grown in different environments

| Genotypes(Codes) | CH1 | CH2 | BM1 | BM2 | GM1 | GM2 | JK1 | JK2 | LG1 | LG2 | TL1 | TL2 | KD1 | KD2 | C.V | Genotype Mean## |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch 291-P1(V1) | 1332.9 | 342.6 | 291.6 | 996.4 | 640.0 | 328.9 | 242.0 | 235.4 | 286.9 | 184.8 | 417.5 | 517.5. | 128.8 | 106.1 | 44.5 | 432.3 a |
| Ch 254(V9) | 1423.0 | 267.6 | 265.0 | 894.5 | 475.0 | 197.7 | 97.8 | 173.7 | 252.2 | 214.5. | 382.5 | 392.9. | 237.4 | 118.0 | 45.6 | 389.6 abc |
| Ch Ch 284-6 (V15) | 1551.5 | 441.3 | 173.7 | 977.5 | 604.7 | 153.0 | 60.2 | 289.7 | 187.8 | 134.4 | 282.5 | 306.1 | 363.9 | 144.8 | 45.6 | 405.1 ab |
| Purple Chilli (V16) | 1192.8 | 359.3 | 162.2 | 738.9 | 326.0 | 276.1 | 196.1 | 382.8 | 168.9 | 191.0 | 435.0 | 266.3 | 290.9 | 101.5 | 39.3 | 363.4 bcd |
| Ch 257 (V25) | 1520.2 | 484.1 | 162.7 | 398.0 | 413.4 | 113.7 | 139.3 | 238.4 | 120.1 | 112.6 | 132.5 | 319.7 | 204.2 | 60.4 | 51.1 | 315.7 de |
| Ch 252-C (V28) | 875.5 | 206.2 | 189.8 | 965.0 | 564.7 | 152.6 | 48.7 | 258.5 | 385.8 | 170.4 | 372.5 | 374.5. | 411.3 | 55.9 | 38.6 | 359.4 bcd |
| Ch Ch 286 (V31) | 901.5 | 202.0 | 189.4 | 803.9 | 357.4 | 117.6 | 82.5 | 234.0 | 206.3 | 129.8 | 212.5 | 522.2. | 218.6 | 89.9 | 37.6 | 304.8 de |
| Ch 291 (V32) | 1163.0 | 386.7 | 320.9 | 638.4 | 671.6 | 123.6 | 196.6 | 498.8 | 201.0 | 133.4 | 395.0 | 492.6. | 59.0 | 62.9 | 43.9 | 381.7 abc |
| Ch 281 (V36) | 977.4 | 220.8 | 77.5 | 381.8 | 283.9 | 112.4 | 142.2 | 223.8 | 158.6 | 76.1 | 162.5 | 233.7. | 89.6 | 50.1 | 50.2 | 227.9 f |
| CK #1T (V38) | 1156.4 | 259.7 | 369.3 | 789.9 | 520.5 | 142.1 | 108.4 | 248.4 | 115.5 | 126.5 | 310.0 | 344.6. | 541.0 | 20.5 | 41.8 | 360.9 bcd |
| Huey Sithon (V39) | 952.7 | 292.7 | 148.8 | 667.7 | 509.5 | 155.1 | 208.7 | 232.0 | 337.5 | 86.0 | 250.0 | 334.2. | 282.9 | 74.2 | 42.9 | 323.7 de |
| Kulai (V40) | 1121.9 | 336.2 | 185.4 | 732.5 | 508.8 | 231.5 | 56.1 | 282.4 | 333.3 | 210.3 | 315.0 | 700.2. | 323.0. | 100.0 | 30.0 | 388.3 abc |
| Cabe Berebes (V44) | 1374.2 | 293.8 | 258.5 | 752.0 | 330.4 | 230.9 | 252.5 | 535.4 | 305.5 | 148.3 | 372.5 | 424.6 | 322.2 | 59.1 | 36.1 | 404.3 ab |
| Ch 234-14(V46) | 1357.3 | 330.8 | 121.9 | 748.2 | 609.7 | 244.8 | 193.2 | 430.2 | 254.8 | 104.7 | 420.0 | 350.0 | 267.2 | 104.9 | 37.4 | 395.6 ab |
| Ch 252- C-P (V49) | 702.4 | 150.0 | 153.6 | 931.1 | 516.0 | 176.0 | 270.0 | 327.9 | 361.6 | 163.2 | 375.0 | 187.6 | 288.4 | 34.4 | 44.7 | 331.2 cde |
| Ch 385 (V54) | 622.1 | 300.2 | 134.2 | 550.7 | 370.7 | 78.8 | 29.2 | 165.4 | 181.1 | 119.9 | 75.0 | 458.2 | 240.8 | 21.7 | 56.0 | 239.1 f |
| 01110-1(V56) | 816.7 | 263.5 | 122.4 | 929.7 | 435.3 | 209.2 | 97.7 | 170.9 | 189.6 | 163.2 | 380.0 | 360.1 | 343.9 | 343.6 | 44.3 | 344.7 bcd |
| Ch 388(V57) | 1237.8 | 319.3 | 316.2 | 907.7 | 822.2 | 196.8 | 265.9 | 380.1 | 339.9 | 229.5 | 250.0 | 543.5 | 176.0 | 218.1 | 42.3 | 443.1 a |
| Ch 389(V58) | 1289.2 | 504.0 | 201.3 | 774.5 | 611.3 | 298.2 | 453.2 | 351.6 | 365.3 | 123.1 | 282.5 | 638.7 | 180.8 | 114.9 | 38.2 | 442.0 a |
| Ch 393(V61) | 1186.1 | 467.3 | 238.7 | 103.3 | 783.0 | 231.4 | 180.8 | 173.0 | 175.4 | 223.0 | 275.0 | 713.3 | 484.1 | 62.3 | 42.9 | 444.7 a |
| MC 4(V63) | 1715.6 | 596.3 | 325.3 | 969.0 | 425.1 | 221.8 | 119.2 | 310.7 | 309.8 | 243.1 | 300.0 | 405.2 | 238.7 | 103.4 | 41.9 | 446.3 a |
| India Sanam (V64) | 591.8 | 201.3 | 144.0 | 835.3 | 481.2 | 921.5 | 51.8 | 173.7 | 53.0 | 156.0 | 232.5 | 361.4 | 407.2 | 46.3 | 53.0 | 273.4 ef |
| C.V | 21.9 | 35.7 | 47.5 | 24.9 | 21.6 | 32.3 | 53.5 | 49.9 | 35.7 | 74.0 | 39.9 | 46.4 | 72.8 | 38.8 | 39.0 | 39.0 |
| Environment mean # | 1139.2a | 328.4e | 206.9hi | 791.6b | 511.8c | 192.7i | 157.2j | 290.0ef | 240.4g | 156.5j | 301.3ef | 420.3 | 277.3fg | 95.2k | | 364.4 |
| Means of 2 seasons # | 733.8 a | | 499.3 b | | 348.7 c | | 223.6 d | | 198.5 d | | 360.8 c | | 186.2 d | | | |

JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season; #, ## @ Mean separation in row, column by Duncan's multiple range test, values with similar letters are not significantly different at 5% level.

Table 4.9. Mean values of number of fruits/plant for genotypes grown in different environments

| Genotypes (Codes) | CH1 | CH2 | BM1 | BM2 | GM1 | GM2 | JK1 | JK2 | LG1 | LG2 | TL1 | TL2 | KD1 | KD2 | C.V | Genotype |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch 291-P (V1) | 117.1 | 32.3 | 42.8 | 140.5 | 92.5 | 352.3 | 39.9 | 61.6 | 56.8 | 25.7 | 47.7 | 76.9 | 35.8 | 20.6 | 34.78 | 589.6 g |
| Ch 254 (V9) | 162.3 | 32.4 | 74.3 | 172.0 | 100.1 | 261 | 30.6 | 92.3 | 79.5 | 41.2 | 83.8 | 124.4 | 42.8 | 26.1 | 50.34 | 77.7 efg |
| Ch 284-6 (V15) | 115.1 | 44.8 | 32.9 | 173.9 | 293.5 | 324.3 | 15.0 | 194.8 | 47.9 | 24.5 | 38.4 | 115.3 | 50.3 | 24.4 | 106.3 | 85.9 e |
| Purple Chilli (V16) | 225.1 | 66.1 | 93.6 | 291.6 | 94.5 | 619.5 | 95.6 | 191.1 | 80.3 | 61.2 | 124.4 | 99.6 | 99.2 | 32.3 | 46.64 | 115.5 d |
| Ch 257 (V25) | 213.0 | 60.0 | 52.5 | 140.2 | 93.4 | 222.8 | 41.2 | 96.6 | 44.6 | 25.0 | 34.2 | 77.6 | 48.6 | 17.0 | 53.35 | 690.1 efg |
| Ch 252-C (V28) | 247.4 | 41.1 | 148.3 | 592.1 | 207.7 | 449.5 | 49.7 | 129.0 | 239.3 | 61.4 | 211.3 | 194.5 | 59.6 | 16.3 | 39.39 | 160.2 b |
| Ch Ch 286 (V31) | 248.4 | 98.3 | 109.4 | 377.0 | 172.8 | 501 | 68.9 | 162.0 | 132.2 | 48.4 | 103.5 | 144.6 | 75.4 | 44.9 | 46.18 | 131.1 cd |
| Ch 291 (V32) | 110.3 | 34.7 | 57.6 | 135.3 | 95.8 | 213.3 | 42.5 | 193.3 | 50.0 | 35.0 | 52.3 | 135.3 | 50.6 | 17.7 | 32.14 | 71.5 efg |
| Ch 281 (V36) | 195.8 | 54.0 | 36.0 | 136.9 | 71.4 | 398.8 | 59.1 | 170.0 | 84.0 | 35.3 | 64.4 | 45.6 | 26.4 | 19.2 | 66.03 | 74.1 efg |
| CK #1T (V38) | 223.2 | 50.6 | 137.3 | 206.0 | 159.8 | 411.8 | 68.0 | 178.0 | 60.6 | 58.6 | 97.7 | 125.8 | 209.3 | 11.3 | 62.14 | 116.5 cd |
| Huey Sithon (V39) | 204.1 | 83.7 | 127.0 | 410.5 | 191.8 | 691.3 | 170.9 | 162.3 | 160.0 | 53.5 | 96.7 | 121.1 | 77.3 | 24.9 | 34.55 | 139.5 bc |
| Kulai (V40) | 125.6 | 37.2 | 43.2 | 140.4 | 99.1 | 386.5 | 14.7 | 79.2 | 77.2 | 47.1 | 56.1 | 114.3 | 51.5 | 21.7 | 33.65 | 67.6 efg |
| Cabe Berebes (V44) | 201.1 | 79.4 | 91.0 | 201.7 | 101.0 | 337.8 | 143.5 | 322.4 | 143.6 | 73.5 | 90.9 | 130.9 | 148.2 | 30.7 | 38.63 | 128.0 cd |
| Ch 234-14(V46) | 108.9 | 29.0 | 55.0 | 121.9 | 73.0 | 442.3 | 50.0 | 94.2 | 55.2 | 20.8 | 64.6 | 81.2 | 27.9 | 18.3 | 26.75 | 60.3 fg |
| Ch(252- C-P (V49) | 286.9 | 92.2 | 159.1 | 539.4 | 318.8 | 1349 | 363.0 | 336.5 | 344.4 | 239.2 | 258.5 | 205.2 | 221.4 | 39.9 | 48.08 | 252.8 a |
| Ch 385 (V54) | 698.3 | 58.0 | 105.8 | 313.5 | 181.3 | 354.3 | 21.8 | 93.2 | 186.5 | 65.9 | 43.6 | 226.5 | 76.5 | 74.3 | 44.63 | 122.4 cd |
| 09110-1 (V56) | 98.5 | 33.8 | 38.4 | 217.3 | 83.2 | 408.3 | 25.8 | 72.2 | 66.6 | 31.6 | 60.9 | 83.4 | 51.9 | 51.9 | 35.18 | 68.3 efg |
| Ch 388 (V57) | 103.4 | 43.7 | 44.8 | 259.0 | 100.8 | 432.5 | 66.2 | 96.0 | 64.5 | 60.4 | 31.7 | 122.0 | 19.4 | 17.6 | 38.23 | 76.6 efg |
| Ch 389 (V58) | 93.6 | 34.3 | 34.1 | 176.4 | 99.0 | 383.5 | 90.2 | 104.6 | 162.8 | 18.0 | 38.4 | 98.5 | 37.3 | 19.3 | 83.33 | 73.5 efg |
| Ch 393 (V61) | 104.1 | 73.9 | 39.3 | 264.4 | 84.5 | 455 | 45.2 | 99.6 | 35.0 | 72.6 | 31.6 | 139.3 | 82.9 | 13.8 | 57.83 | 81.2 efg |
| MC 4(V63) | 137.8 | 55.9 | 60.8 | 157.8 | 307.3 | 638.3 | 25.6 | 92.3 | 67.5 | 34.4 | 38.2 | 78.0 | 39.4 | 17.6 | 101.5 | 84.6 ef |
| Indian Sanam (V64) | 200.0 | 56.9 | 80.7 | 433.3 | 107.2 | 400.0 | 37.8 | 140.2 | 42.4 | 77.5 | 98.8 | 155.8 | 138.9 | 21.6 | 39.16 | 116.5 cd |
| C.V | 30.1 | 32.7 | 52.1 | 26.71 | 67.2 | 35.81 | 89.57 | 65.2 | 59.2 | 75.7 | 56.1 | 41.93 | 80.14 | 36.59 | 56.75 | 56.75 |
| Environment mean | 173.6b | 54.7gh | 75.6f | 254.6a | 142.2c | 45.6h | 75.7ef | 143.5c | 103.7e | 55.0gh | 80.4f | 122.5d | 75.9f | 23.4c | | 101.4 |
| Mean of 2 seasons # | 113.9b | | 165.1a | | 93.9d | | 107.3b | | 79.3 e | | 101.4 d | | 48.9f | | | |

JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season;
CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season;
KD1, KD2 @Kundang 1st planting-season, 2nd planting-season; #, ## @ Mean separation in row, column by Duncan's multiple range test, values with similar letters are not significantly different at 5% level.

Table 4.10. Mean values of mean fruit weight (g/fruit) for genotypes grown in different environments

| Genotypes (Codes) | CH1 | CH2 | BM1 | BM2 | GM1 | GM2 | JK1 | JK2 | LG1 | LG2 | TL1 | TL2 | KD1 | KD2 | C.V | Genotype mean ## |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch 291-P (V1) | 11.2 | 10.8 | 7.2 | 7.2 | 7.0 | 9.6 | 5.7 | 3.9 | 5.1 | 6.2 | 9.5 | 6.9 | 9.5 | 5.1 | 27.22 | 7.51 a |
| Ch 254 (V9) | 9.0 | 9.0 | 3.3 | 5.2 | 4.7 | 7.8 | 1.4 | 2.4 | 3.2 | 4.1 | 4.5 | 4.2 | 9.0 | 4.6 | 26.02 | 5.17 e |
| Ch Ch 284-6 (V15) | 13.0 | 9.9 | 5.5 | 5.6 | 5.6 | 4.6 | 3.5 | 1.8 | 3.9 | 6.2 | 7.4 | 1.3 | 9.8 | 7.0 | 23.11 | 6.1 cd |
| Purple Chilli (V16) | 5.4 | 5.5 | 1.8 | 3.1 | 3.4 | 4.6 | 2.1 | 2.1 | 2.1 | 2.8 | 3.5 | 2.7 | 5.1 | 4.2 | 24.39 | 3.44 g |
| Ch 257(V25) | 7.2 | 7.6 | 3.4 | 2.9 | 4.4 | 5.0 | 3.1 | 2.5 | 2.9 | 3.6 | 3.8 | 4.8 | 5.2 | 3.6 | 25.49 | 4.28 f |
| Ch 252-C(V28) | 3.6 | 5.3 | 1.3 | 1.7 | 2.7 | 3.4 | 1.2 | 2.1 | 1.6 | 2.6 | 2.0 | 2.3 | 4.8 | 3.6 | 32.08 | 2.71 h |
| Ch Ch 286 (V31) | 3.7 | 2.1 | 1.8 | 2.2 | 2.1 | 2.4 | 1.2 | 1.5 | 1.5 | 4.0 | 2.4 | 6.4 | 3.3 | 2.4 | 30.65 | 2.63 hi |
| Ch 291(V32) | 10.9 | 11.2 | 5.6 | 4.7 | 7.4 | 5.6 | 4.7 | 2.6 | 4.0 | 3.5 | 7.3 | 9.5 | 5.2 | 3.6 | 22.49 | 6.12 cd |
| Ch 281(V36) | 5.0 | 4.2 | 2.2 | 2.9 | 4.5 | 3.0 | 1.5 | 1.9 | 1.9 | 2.0 | 3.1 | 2.7 | 3.8 | 2.7 | 31.25 | 2.94 gh |
| CK #1T(V38) | 5.4 | 4.6 | 2.7 | 3.8 | 3.9 | 3.3 | 1.7 | 1.5 | 1.9 | 2.6 | 3.3 | 2.6 | 4.1 | 1.9 | 30.08 | 3.04 gh |
| Huey Sithon (V39) | 5.3 | 3.6 | 1.2 | 1.6 | 2.7 | 2.4 | 1.3 | 1.5 | 2.2 | 1.6 | 2.5 | 2.5 | 5.3 | 3.0 | 31.95 | 2.61 d |
| Kulai (V40) | 9.3 | 8.9 | 4.3 | 5.2 | 5.1 | 5.7 | 4.1 | 3.8 | 4.9 | 5.8 | 5.7 | 6.7 | 7.9 | 4.7 | 21.13 | 5.86 d |
| Cabe Berebes (V44) | 6.9 | 3.7 | 2.9 | 3.7 | 3.2 | 6.5 | 1.8 | 1.6 | 2.2 | 2.3 | 4.1 | 3.5 | 2.7 | 1.9 | 30.48 | 3.36 g |
| Ch 234-14(V46) | 12.4 | 11.8 | 2.6 | 6.2 | 8.2 | 5.6 | 4.1 | 4.3 | 4.6 | 5.0 | 6.5 | 4.6 | 9.2 | 5.8 | 21.18 | 6.48 bc |
| Ch 252- C-P (V49) | 2.4 | 1.2 | 1.1 | 1.8 | 1.7 | 1.5 | 0.7 | 1.4 | 1.1 | 1.1 | 1.6 | 0.9 | 1.3 | 1.1 | 42.09 | 1.34 k |
| Ch 385 (V54) | 2.0 | 5.0 | 1.2 | 1.8 | 2.1 | 2.3 | 1.1 | 1.6 | 1.2 | 1.8 | 1.3 | 1.4 | 3.7 | 2.8 | 51.84 | 2.08 j |
| 01110-1(V56) | 7.7 | 7.5 | 3.3 | 3.3 | 5.2 | 5.0 | 2.6 | 2.6 | 2.9 | 4.8 | 6.0 | 4.3 | 6.2 | 6.7 | 38.75 | 4.92 e |
| Ch 388(V57) | 12.1 | 8.5 | 6.3 | 3.5 | 8.1 | 4.9 | 4.4 | 4.1 | 5.2 | 3.5 | 6.8 | 8.3 | 7.8 | 9.9 | 24.42 | 6.66 b |
| Ch 389(V58) | 14.0 | 14.4 | 6.0 | 4.8 | 6.5 | 8.6 | 3.7 | 4.0 | 4.2 | 6.9 | 6.8 | 6.1 | 8.9 | 5.8 | 28.45 | 7.24 a |
| Ch 393(V61) | 11.9 | 6.3 | 6.4 | 3.9 | 9.3 | 4.9 | 3.4 | 2.0 | 4.9 | 2.6 | 7.9 | 8.5 | 6.8 | 4.5 | 22.17 | 5.95 d |
| MC 4(V63) | 12.7 | 10.7 | 5.4 | 6.1 | 3.3 | 5.1 | 3.3 | 3.1 | 4.5 | 6.0 | 7.0 | 5.3 | 8.9 | 6.2 | 33.21 | 6.25 bcd |
| IndiaSanam (V64) | 3.0 | 3.7 | 1.8 | 2.0 | 2.5 | 2.2 | 1.1 | 1.0 | 2.0 | 1.8 | 2.3 | 2.2 | 3.2 | 2.1 | 20.08 | 2.19 ij |
| C.V | 24.71 | 29.56 | 24.98 | 22.49 | 24.8 | 33.7 | 31.8 | 30.79 | 27.36 | 30.32 | 30.79 | 24.69 | 23.83 | 16.15 | 27.72 | 27.72 |
| Environment mean # | 7.93a | 7.05b | 3.49fg | 3.81fg | 4.68d | 4.72d | 2.61h | 2.41h | 3.11g | 3.67f | 4.78d | 4.44de | 5.99c | 4.2e | | 4.49 |
| Mean of 2 seasons # | 7.5a | | 3.7d | | 4.7c | | 2.5e | | 3.4d | | 4.6c | | 5.1b | | | |

JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season;
CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season;
KD1, KD2 @Kundang 1st planting-season, 2nd planting-season; #, ## @ Mean separation in row, column by Duncan's multiple range test, values with similar letters are not significantly different at 5% level.

Table 4.11. Mean values of dry yield (g/plant) for genotypes grown in different environments

| Genotypes ( codes) | CH1 | CH2 | BM1 | BM2 | GM1 | GM2 | JK1 | JK2 | LG1 | LG2 | TL1 | TL2 | KD1 | KD2 | C.V | Genotype mean ## |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch 291-P(V1) | 177.9 | 55.1 | 43.3 | 204.8 | 97.6 | 51.3 | 31.5 | 37.1 | 48.1 | 31.1 | 50.4 | 98.1 | 13.5 | 11.5 | 50.5 | 67.8 bcde |
| Ch 254(V9) | 216.8 | 42.1 | 49.3 | 182.5 | 78.0 | 41.4 | 16.7 | 38.2 | 45.1 | 36.0 | 54.6 | 76.8 | 47.8 | 29.7 | 60.7 | 68.2bcde |
| Ch 284-6 (V15) | 244.4 | 82.9 | 30.5 | 214.0 | 113.5 | 31.1 | 12.0 | 57.6 | 32.6 | 20.3 | 37.0 | 71.7 | 56.6 | 30.9 | 51.6 | 73.9abcd |
| Purple Chilli (V16) | 180.5 | 98.2 | 41.3 | 193.8 | 73.4 | 50.1 | 33.4 | 65.1 | 39.2 | 39.1 | 63.0 | 46.4 | 39.8 | 20.0 | 49.1 | 70.2abcde |
| Ch 257 (V25) | 240.9 | 98.0 | 36.5 | 92.0 | 94.6 | 21.9 | 22.9 | 41.0 | 22.0 | 22.8 | 20.5 | 80.1 | 15.4 | 11.7 | 57.8 | 58.6ef |
| Ch 252-C (V28) | 152.2 | 37.3 | 54.0 | 273.8 | 139.8 | 21.9 | 13.3 | 48.3 | 74.9 | 32.8 | 68.2 | 83.0 | 49.3 | 16.0 | 50.7 | 76.8abc |
| Ch 286(V31) | 151.6 | 52.4 | 54.3 | 239.7 | 113.5 | 25.4 | 21.0 | 56.2 | 46.8 | 32.5 | 45.6 | 101.8 | 27.2 | 23.6 | 35.4 | 70.8abcde |
| Ch 291 (V32) | 203.4 | 67.8 | 64.8 | 116.2 | 132.1 | 44.3 | 24.7 | 70.7 | 32.3 | 23.5 | 52.8 | 86.0 | 6.5 | 12.9 | 45.5 | 67.0bcde |
| Ch 281 (V36) | 162.3 | 42.6 | 18.5 | 73.2 | 63.3 | 29.4 | 22.0 | 44.6 | 35.6 | 13.3 | 28.6 | 49.3 | 12.0 | 10.3 | 53.9 | 43.2g |
| CK #1T (V38) | 240.8 | 61.2 | 67.6 | 194.2 | 112.2 | 29.5 | 19.5 | 49.1 | 26.7 | 26.8 | 53.4 | 82.5 | 56.7 | 5.4 | 40.9 | 73.2abcd |
| Huey Sithon (V39) | 189.8 | 65.8 | 46.6 | 190.9 | 127.5 | 40.2 | 56.2 | 53.0 | 80.4 | 18.0 | 48.6 | 87.4 | 33.2 | 17.1 | 38.9 | 75.3abcd |
| Kulai (V40) | 156.6 | 58.8 | 41.8 | 151.0 | 95.6 | 42.0 | 13.4 | 40.7 | 58.5 | 40.7 | 45.3 | 92.8 | 40.8 | 15.4 | 32.8 | 63.9cdef |
| Cabe Berebes (V44) | 185.7 | 65.0 | 55.3 | 181.4 | 78.9 | 31.4 | 47.2 | 93.1 | 69.0 | 35.0 | 57.9 | 108.7 | 38.9 | 13.8 | 39.6 | 82.9a |
| Ch 234-14 (V46) | 242.7 | 41.2 | 23.4 | 145.6 | 99.2 | 43.4 | 34.7 | 65.9 | 54.0 | 16.1 | 58.2 | 89.0 | 33.3 | 14.4 | 41.4 | 68.7bcde |
| Ch(252- C-P- (V49) | 127.1 | 37.4 | 38.5 | 254.8 | 138.1 | 32.9 | 68.3 | 69.1 | 113.3 | 32.1 | 69.2 | 45.8 | 48.6 | 8.9 | 46.8 | 77.42ab |
| Ch 385 (V54) | 132.6 | 68.6 | 35.5 | 138.0 | 117.6 | 21.7 | 7.60 | 31.8 | 38.3 | 26.5 | 14.9 | 86.8 | 15.1 | 5.3 | 48.5 | 52.9fg |
| 09110-1(V56) | 124.2 | 43.7 | 34.4 | 183.4 | 74.5 | 36.8 | 22.8 | 23.9 | 38.7 | 26.3 | 55.4 | 88.9 | 38.4 | 42.6 | 43.8 | 59.6ef |
| Ch 388(V57) | 154.6. | 57.5 | 50.5 | 216.0 | 139.5 | 27.0 | 34.8 | 52.8 | 56.8 | 36.8 | 28.5 | 89.4 | 18.9 | 36.7 | 48.9 | 71.4abcde |
| Ch 389(V58) | 209.7 | 84.9 | 34.3 | 147.5 | 108.9 | 39.5 | 64.6 | 44.2 | 60.0 | 16.5 | 31.3 | 80.1 | 21.9 | 14.9 | 46.3 | 68.4bcde |
| Ch 393(V61) | 179.4 | 95.2 | 41.9 | 215.6 | 129.5 | 49.4 | 27.6 | 36.7 | 31.0 | 56.3 | 31.3 | 123.2 | 56.8 | 31.9 | 46.8 | 79.0ab |
| MC 4(V63) | 241.8 | 112.3 | 51.1 | 182.8 | 63.0 | 49.8 | 11.6 | 43.3 | 49.3 | 36.4 | 34.8 | 55.8 | 28.8 | 11.6 | 44.9 | 69.4bcde |
| Indian Sanam (V64) | 131.1 | 49.5 | 34.0 | 239.1 | 139.1 | 21.1 | 10.8 | 35.6 | 15.1 | 29.0 | 43.3 | 80.6 | 46.9 | 10.6 | 51.8 | 63.3def |
| CV (%) | 22.3 | 48.8 | 46.29 | 28.25 | 25.5 | 40.6 | 55.6 | 55.2 | 42.7 | 77.3 | 38.9 | 55.2 | 82.1 | 43.5 | 42.7 | |
| Environment mean # | 188.4a | 64.3d | 43.1ef | 183.2a | 105.9b | 36.0fg | 28.0g | 50.0e | 48.5e | 29.4g | 45.1e | 82.0c | 33.9g | 18.0h | | 68.3 |
| Mean of 2 seasons# | 126.4a | | 113.1b | | 70.9c | | 39.0e | | 39.0e | | 63.6d | | 25.9f | | | |

JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season; #, ## @ Mean separation in row, column by Duncan's multiple range test, values with similar letters are not significantly different at 5% level.

Table 4.12 Mean values of days to harvest for genotypes grown in different environments

| GENOTYPES (Codes) | CH1 | CH2 | BM1 | BM2 | GM1 | GM2 | JK1 | JK2 | LG1 | LG2 | TG1.0 | TG2 | KD1 | CH2 | CV | Genotype mean ## |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch 291-P(V1) | 124.0 | 125.0 | 76.8 | 80.0 | 80.5 | 78.5 | 90.7 | 67.3 | 74.0 | 90.0 | 67.0 | 63.0 | 88.0 | 78.0 | 1.40 | 84.5 e |
| Ch 254(V9) | 104.0 | 125.0 | 72.0 | 80.3 | 81.0 | 78.5 | 91.0 | 67.0 | 74.0 | 90.0 | 67.0 | 63.0 | 88.0 | 78.0 | 1.38 | 82.8 i |
| Ch 284-6 (V15) | 104.0 | 108.0 | 72.0 | 73.0 | 77.0 | 75.0 | 72.0 | 65.0 | 57.0 | 73.0 | 67.0 | 63.0 | 71.0 | 61.0 | 0.00 | 74.1 n |
| Purple Chilli (V16) | 104.0 | 122.0 | 72.0 | 80.0 | 78.0 | 75.0 | 96.0 | 65.0 | 74.0 | 88.0 | 70.0 | 68.0 | 84.0 | 78.0 | 0.00 | 81.9 k |
| Xian Ch257(V25) | 104.0 | 104.0 | 63.0 | 80.0 | 79.0 | 75.0 | 89.0 | 65.0 | 74.0 | 90.0 | 67.0 | 63.0 | 88.0 | 78.0 | 0.49 | 79.9 l |
| Ch 252-C(V28) | 103.0 | 125.0 | 77.0 | 82.8 | 85.0 | 75.3 | 92.0 | 65.0 | 74.3 | 90.0 | 67.0 | 63.0 | 92.5 | 78.0 | 0.82 | 83.6 g |
| Ch 286 (31) | 127.0 | 125.0 | 65.0 | 83.0 | 85.3 | 80.3 | 92.0 | 68.0. | 74.0 | 90.0 | 67.0 | 63.0 | 88.0 | 78.0 | 1.20 | 84.7 cde |
| Ch 291(V32) | 104.0 | 101.0 | 63.0 | 58.0 | 58.0 | 82.0 | 66.0 | 65.0 | 65.0 | 67.0 | 56.0 | 52.0 | 64.0 | 60.0 | 0.00 | 68.6 p |
| Ch 281(V36) | 104.0 | 125.0 | 63.0 | 80.0 | 79.0 | 76.8 | 89.0 | 69.0 | 73.8 | 90.0 | 67.0 | 63.0 | 88.3 | 78.0 | 1.21 | 81.8 k |
| CK #1T(V38) | 129.0 | 125.0 | 63.0 | 84.0 | 86.0 | 82.0 | 89.0 | 69.0 | 74.0 | 90.0 | 67.0 | 63.0 | 88.0 | 78.0 | 0.001 | 84.8 cd |
| Huey Sithon (V39) | 133.0 | 125.0 | 65.0 | 89.0 | 90.0 | 75.0 | 96.0 | 74.0 | 83.0 | 99.0 | 76.0 | 72.0 | 97.0 | 87.0 | 0.00 | 90.1 a |
| Kulai (V40) | 128.0 | 125.0 | 72.0 | 84.0 | 86.0 | 75.0 | 93.0 | 69.0 | 78.0 | 90.0 | 40.0 | 68.0 | 88.0 | 78.0 | 0.46 | 86.1 b |
| Cabe Berebes (V44) | 104.0 | 125.0 | 77.0 | 80.0 | 82.0 | 82.0 | 89.0 | 69.0 | 74.0 | 94.0 | 44.0 | 68.0 | 88.0 | 81.5 | 0.31 | 84.9 c |
| MC11(V46) | 104.0 | 124.5 | 77.0 | 80.0 | 81.0 | 81.0 | 88.0 | 65.0 | 78.0 | 89.0 | 67.0 | 63.0 | 88.0 | 77.3 | 0.24 | 83.1 h |
| Ch 252- C-P (V49) | 104.0 | 124.8 | 77.0 | 84.0 | 82.0 | 75.0 | 93.0 | 65.0 | 74.0 | 90.0 | 70.0 | 66.0 | 88.0 | 78.0 | 0.87 | 83.6 g |
| Ch385(V54) | 104.0 | 100.0 | 65.0 | 80.0 | 79.0 | 82.0 | 89.0 | 65.0 | 74.0 | 90.0 | 67.0 | 63.0 | 76.0 | 56.0 | 0.49 | 77.9 m |
| Ch387 01110-1 (V56) | 104.0 | 125.0 | 72.0 | 80.0 | 82.0 | 75.0 | 89.0 | 65.0 | 74.0 | 90.0 | 67.0 | 63.0 | 88.0 | 78.0 | 0.001 | 82.3 j |
| Ch388 (V57) | 104.0 | 125.0 | 72.0 | 84.0 | 85.5 | 82.0 | 93.0 | 69.0 | 78.0 | 90.0 | 67.0 | 63.0 | 88.0 | 78.0 | 2.22 | 84.2 f |
| Ch389 (V58) | 104.0 | 125.0 | 72.0 | 80.0 | 82.0 | 75.0 | 93.0 | 65.0 | 78.0 | 90.0 | 67.0 | 63.0 | 88.0 | 78.0 | 0.00 | 82.9 hi |
| Ch393 (V61) | 124.0 | 125.0 | 72.0 | 84.0 | 82.0 | 75.0 | 93.0 | 69.0 | 77.3 | 90.0 | 67.0 | 63.0 | 88.0 | 78.0 | 0.47 | 84.8 cd |
| MC4 (V63) | 104.0 | 125.0 | 77.0 | 67.0 | 69.0 | 69.0 | 68.0 | 65.0 | 65.5 | 69.0 | 67.0 | 63.0 | 66.0 | 56.0 | 0.85 | 72.1 o |
| India Sanam (V64) | 104.0 | 125.0 | 77.0 | 80.0 | 96.0 | 75.0 | 89.0 | 69.0 | 74.0 | 90.0 | 71.0 | 67.0 | 88.3 | 78.0 | 0.16 | 84.5 de |
| C.V (%) | 0.39 | 0.14 | 0.15 | 0.47 | 1.91 | 2.06 | 0.12 | 0.16 | 1.63 | 0.20 | 0.63 | 0.67 | 0.23 | 0.32 | 0.88 | |
| Environmental mean# | 110.4b | 119a | 70.99j | 79.9f | 81.1e | 77.2g | 87.7c | 67.01*l* | 73.7i | 87.7c | 67.7k | 63.9m | 85.0d | 75.0h | | 81.95 |
| Means of 2 seasons# | | 115.1 a | | 75.4 f | | 79.2 d | | 77.4 e | | 80.7 b | | 65.8 g | | 80.0c | | |

JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season; #, ## @ Mean separation in row, column by Duncan's multiple range test, values with similar letters are not significantly different at 5% level.

Table 4.13 Mean values of plant height (cm) for genotypes grown in different environments.

| GENOTYPES (Codes) | CH2 | GM1 | GM2 | JK1 | JK2 | LG2 | KD1 | KD2 | CV (%) | Genotype Mean ## |
|---|---|---|---|---|---|---|---|---|---|---|
| Ch291-P (V1) | 56.3 | 78.0 | 62.3 | 55.2 | 66.8 | 43.4 | 61.2 | 61.2 | 16.4 | 60.6 cd |
| Ch254(V9) | 59.6 | 73.9 | 72.8 | 58.9 | 58.2 | 49.7 | 46.2 | 39.0 | 11.5 | 57.4 de |
| ChCh 284-6(V15) | 51.0 | 68.4 | 56.9 | 51.3 | 50.2 | 39.8 | 44.1 | 35.0 | 12.3 | 49.6 f |
| Purple Chilli(V16) | 65.7 | 87.7 | 66.3 | 61.17 | 77.7 | 36.4 | 66.7 | 41.2 | 11.8 | 62.8 c |
| Xian Ch257(V25) | 50.1 | 62.8 | 43.9 | 48.1 | 57.7 | 39.1 | 44.4 | 39.9 | 18.1 | 48.2 fg |
| Ch252-C (V28) | 68.6 | 83.7 | 62.7 | 77.2 | 74.8 | 45.9 | 44.2 | 39.8 | 16.9 | 62.1 c |
| Ch286 (V31) | 51.8 | 44.6 | 45.8 | 48.5 | 45.3 | 41.0 | 39.9 | 25.3 | 12.2 | 42.8 h |
| Ch291(V32) | 53.8 | 83.2 | 58.1 | 63 | 62.6 | 38.7 | 44.6 | 38.4 | 15.5 | 55.3 e |
| Hantaka Ch281(V36) | 52.9 | 58.3 | 49.2 | 54.2 | 55.0 | 34.8 | 30.9 | 24.0 | 15.3 | 44.9 gh |
| Taiwan dc (V38) | 51.0 | 58.1 | 61.4 | 59.7 | 46.2 | 39.7 | 33.1 | 27.9 | 14.5 | 47.1 fg |
| Huey Sithon (V39) | 66.9 | 85.5 | 68.3 | 58.8 | 74.0 | 39.0 | 53.1 | 34.9 | 12.9 | 60.1 cd |
| Kulai (V40) | 64.6 | 77.0 | 72.0 | 66.0 | 56.7 | 64.6 | 63.0 | 46.6 | 14.0 | 63.7 c |
| Cabe Berebes (V44) | 54.8 | 77.5 | 66.6 | 56.4 | 57.7 | 41.2 | 53.2 | 36.1 | 16.8 | 55.4 e |
| MC11 (46) | 69.4 | 84.7 | 77.2 | 78.0 | 76.7 | 44.7 | 64.5 | 59.7 | 18.2 | 69.3 b |
| Ch 252- C(P) (V49) | 73.4 | 88.9 | 88.7 | 71.2 | 88.8 | 50.5 | 81.1 | 62.4 | 9.55 | 75.6 a |
| Ch 385 (V54) | 49.8 | 72.4 | 42.8 | 36.00 | 45.5 | 39.6 | 36.6 | 37.8 | 14.2 | 45.0 gh |
| Ch387 01110-1(V56) | 56.4 | 86.4 | 68.5 | 53.7 | 59.2 | 60.3 | 52.7 | 52.7 | 12.8 | 61.2 cd |
| Ch 388(V57) | 48.8 | 88.1 | 72.2 | 65.4 | 77.2 | 43.3 | 40.9 | 40.9 | 12.7 | 59.6 cde |
| Ch 389(V58) | 68.9 | 85.4 | 74.7 | 64.9 | 85.8 | 43.7 | 68.9 | 59.7 | 18.7 | 68.7 b |
| Ch 393(V61) | 62.0 | 99.8 | 54.9 | 70 | 79.2 | 33.3 | 52.5 | 46.6 | 14.6 | 63.3 c |
| MC4(V63) | 62.4 | 86.2 | 58.6 | 71.9 | 64 | 31.2 | 74.3 | 36.2 | 14.2 | 60.6 cd |
| Sanam (V64) | 59.0 | 86.3 | 64.3 | 66.9 | 66.9 | 35.4 | 57.3 | 39.5 | 13.80 | 59.4 cde |
| C.V | 9.57 | 12.0 | 8.53 | 11.55 | 14.98 | 20.00 | 19.0 | 15.61 | 13.78 | |
| Environment mean# | 58.94d | 78.0 | 63.09 | 60.72c | 64.8b | 42.5f | 52.3e | 42.02f | | 57.8 |
| Mean of 2 seasons # | 58.9 c | 70.5 a | | 62.7 b | | 42.5e | 47.2 d | | | |

JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season; #, ## @ Mean separation in row, column by Duncan's multiple range test, values with similar letters are not significantly different at 5% level.

Table 4.14. Mean values of days to dry for genotypes grown in different environments

| GENOTYPES (Codes) | CH1 | CH2 | BM1 | BM2 | GM1 | GM2 | JK1 | JK2 | LG1 | LG2 | TL1 | TL2 | KD1 | KD2 | C.V. (%) | Genotype mean ## |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch 291-P(V1) | 14.5 | 15.8 | 11.0 | 14.0 | 13.8 | 13.3 | 15.0 | 23.0 | 16.0 | 20.5 | 14.3 | 14.3 | 19.0 | 18.0 | 17.94 | 15.9 abcde |
| Ch 254(V9) | 14.0 | 14.8 | 8.8 | 13.3 | 16.3 | 14.8 | 18.0 | 23.0 | 15.3 | 17.3 | 14.8 | 13.5 | 17.3 | 17.3 | 19.54 | 15.6 abcdef |
| Ch Ch 284-6(V15) | 15.8 | 16.3 | 12.0 | 12.3 | 12.5 | 13.5 | 15.5 | 21.5 | 18.0 | 20.3 | 15.5 | 11.3 | 16.8 | 14.8 | 19.83 | 15.4 bcdefg |
| Purple Chilli(V16) | 12.3 | 15.3 | 8.0 | 11.0 | 14.5 | 13.0 | 15.5 | 20.8 | 12.3 | 14.3 | 14.5 | 13.8 | 19.8 | 14.5 | 17.66 | 14.2 gh |
| Xian Ch257(V25) | 16.0 | 16.0 | 9.0 | 11.5 | 14.0 | 12.5 | 14.5 | 19.0 | 11.5 | 18.0 | 15.5 | 15.3 | 20.3 | 15.8 | 18.59 | 14.9 defgh |
| Ch252-C (V28) | 14.0 | 15.8 | 10.3 | 10.5 | 16.0 | 18.0 | 14.5 | 21.5 | 12.3 | 19.5 | 16.3 | 9.5 | 18.8 | 14.5 | 15.78 | 15.1 cdefg |
| Ch286 (V31) | 17.8 | 15.3 | 8.0 | 11.3 | 15.0 | 13.0 | 15.0 | 19.8 | 9.5 | 14.0 | 20.0 | 13.5 | 18.0 | 14.5 | 21.14 | 14.6 efgh |
| Ch291(V32) | 13.5 | 15.5 | 8.0 | 10.8 | 13.3 | 13.8 | 14.8 | 18.0 | 11.0 | 17.8 | 15.3 | 13.5 | 18.0 | 18.0 | 19.74 | 14.4 fgh |
| Hantaka Ch 281(V36) | 12.0 | 18.0 | 9.8 | 12.3 | 13.5 | 14.3 | 16.5 | 24.3 | 14.5 | 17.3 | 13.8 | 14.5 | 15.0 | 17.5 | 18.43 | 15.2 cdefgh |
| Taiwan CK#IT( V38) | 17.3 | 15.5 | 11.0 | 11.3 | 14.5 | 15.5 | 15.8 | 20.8 | 13.0 | 17.3 | 13.3 | 13.5 | 16.5 | 18.0 | 18.22 | 15.2 cdefgh |
| Huey Sithon (V39) | 15.0 | 14.0 | 8.3 | 13.0 | 15.0 | 15.3 | 14.8 | 20.8 | 15.5 | 15.5 | 16.0 | 13.3 | 18.5 | 18.3 | 17.06 | 15.2 cdefgh |
| Kulai (V40) | 18.3 | 16.5 | 10.5 | 12.5 | 15.0 | 16.0 | 15.3 | 20.8 | 15.0 | 14.5 | 15.0 | 12.3 | 20.0 | 23.0 | 27.41 | 16.0 abcd |
| Cabe Berebes (V44) | 12.5 | 16.8 | 9.0 | 11.3 | 13.5 | 15.3 | 15.3 | 21.5 | 14.0 | 19.5 | 13.8 | 12.3 | 18.3 | 13.0 | 20.94 | 14.7 efgh |
| MC11 (V46) | 15.5 | 16.0 | 10.0 | 12.5 | 14.8 | 17.5 | 17.3 | 21.5 | 18.5 | 20.8 | 16.3 | 15.5 | 19.5 | 17.0 | 18.37 | 16.6 ab |
| Ch 252- C-P (V49) | 18.0 | 13.8 | 8.3 | 11.5 | 16.8 | 17.5 | 15.5 | 20.0 | 10.3 | 16.8 | 17.3 | 9.0 | 16.0 | 15.5 | 15.90 | 14.7 efgh |
| Ch 385 (V54) | 18.3 | 13.0 | 9.8 | 11.3 | 16.0 | 15.3 | 15.3 | 22.5 | 10.8 | 18.0 | 15.5 | 15.3 | 16.8 | 18.0 | 14.43 | 15.4 bcdefg |
| Ch387 01110-1 (V56) | 17.5 | 16.8 | 9.8 | 10.8 | 15.8 | 16.0 | 15.0 | 19.8 | 13.0 | 24.3 | 15.8 | 14.5 | 20.3 | 20.3 | 12.89 | 16.4 abc |
| Ch 388 (V57) | 14.5 | 15.3 | 11.0 | 11.5 | 14.3 | 14.3 | 15.0 | 21.5 | 16.0 | 19.5 | 14.5 | 15.0 | 18.0 | 15.0 | 17.84 | 15.4 bcdefg |
| Ch 389(V58) | 18.0 | 16.0 | 11.0 | 12.0 | 14.3 | 15.0 | 14.5 | 14.5 | 17.5 | 19.0 | 26.3 | 12.3 | 18.8 | 18.3 | 37.32 | 16.7 a |
| Ch 393 (V61) | 15.5 | 16.3 | 11.0 | 11.3 | 15.0 | 14.3 | 14.8 | 23.3 | 13.5 | 18.3 | 15.3 | 14.8 | 19.0 | 18.0 | 18.18 | 15.7 abcde |
| MC 4 (V63) | 18.5 | 15.8 | 10.3 | 12.0 | 14.5 | 14.5 | 15.5 | 23.3 | 16.5 | 19.5 | 14.3 | 14.8 | 19.8 | 19.5 | 15.39 | 16.3 abc |
| Indian Sanam (V64) | 12.5 | 13.3 | 9.3 | 11.0 | 12.5 | 12.5 | 16.8 | 22.5 | 10.3 | 16.8 | 14.5 | 12.0 | 19.5 | 14.0 | 18.55 | 14.1 h |
| C.V (%) | 31.04 | 12.75 | 10.95 | 10.57 | 12.63 | 14.79 | 7.77 | 16.36 | 21.89 | 16.80 | 36.47 | 18.92 | 9.24 | 9.89 | 18.68 | |
| Environment mean # | 15.5de | 15.51de | 9.72i | 11.75j | 14.57ef | 14.76e | 15.44de | 21.34a | 13.81fg | 18.10b | 15.78d | 13.33g | 18.34b | 16.93c | | 15.35 |
| Means of 2 seasons# | 15.5 c | | 10.7 e | | 14.7 d | | 18.4 c | | 16.0 c | | 14.6 d | | 17.6 b | | | |

JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season; #, ## @ Mean separation in row, column by Duncan's multiple range test, values with similar letters are not significantly different at 5% level.

Table 4.15. Mean values of conversion rate (solid content as percentage of fresh) for genotypes grown in different environments

| GENOTYPES (Codes) | CH1 | CH2 | BM1 | BM2 | GM1 | GM2 | JK1 | JK2 | LG1 | LG2 | TL1 | TL2 | KD1 | KD2 | CV(%) | Genotype mean ## |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch 291-P (V1) | 13.2 | 15.7 | 14.8 | 20.1 | 15.0 | 16.6 | 13.2 | 15.4 | 16.5 | 16.4 | 12.3 | 19.0 | 10.8 | 10.8 | 18.97 | 15.02 g |
| Ch 254(V9) | 15.3 | 15.7 | 19.1 | 19.9 | 16.0 | 16.4 | 18.0 | 17.6 | 20.0 | 16.6 | 14.0 | 17.6 | 19.5 | 24.8 | 18.09 | 17.89 ef |
| Ch Ch 284-6 (V15) | 15.7 | 19.2 | 17.6 | 21.9 | 19.0 | 19.8 | 23.5 | 20.0 | 17.3 | 15.1 | 13.3 | 22.3 | 13.1 | 22.5 | 21.44 | 18.58 de |
| Purple Chilli (V16) | 15.1 | 27.9 | 24.9 | 26.1 | 24.0 | 18.0 | 16.9 | 17.7 | 23.0 | 20.2 | 14.6 | 16.0 | 12.9 | 20.1 | 21.67 | 19.72 cd |
| Xian Ch 257 (V25) | 15.8 | 19.9 | 22.8 | 23.4 | 23.0 | 18.9 | 17.5 | 17.7 | 22.6 | 20.2 | 15.6 | 23.9 | 10.7 | 19.4 | 11.68 | 19.36 cd |
| Ch252-C (V28) | 17.5 | 17.9 | 27.9 | 27.9 | 25.0 | 20.5 | 27.3 | 19.8 | 26.4 | 19.2 | 17.5 | 24.3 | 11.9 | 29.7 | 15.88 | 22.32 b |
| Ch286 (V31) | 17.3 | 25.6 | 28.9 | 29.9 | 32.0 | 21.3 | 25.3 | 24.1 | 26.2 | 24.9 | 21.7 | 19.8 | 12.2 | 27.2 | 15.24 | 24.01 a |
| Ch291(V32) | 17.4 | 17.4 | 20.1 | 18.3 | 20.0 | 18.8 | 12.5 | 14.0 | 16.1 | 17.9 | 13.6 | 17.3 | 10.5 | 20.6 | 10.23 | 16.73 f |
| Hantaka Ch281(V36) | 16.6 | 19 | 24.5 | 19.1 | 22.0 | 26.8 | 15.3 | 19.1 | 22.3 | 17.6 | 17.0 | 21.9 | 13.5 | 20.8 | 14.61 | 19.60 cd |
| Taiwan dc, CK #1T (V38) | 21.2 | 22.8 | 19 | 24.9 | 22.0 | 20.5 | 17.1 | 19.9 | 23.3 | 21.8 | 17.1 | 24.0 | 10.9 | 26.9 | 16.01 | 20.76 c |
| Huey Sithon (V39) | 20.1 | 22.9 | 31.6 | 29.1 | 25.0 | 25.3 | 26.9 | 24.4 | 24.1 | 21.8 | 18.6 | 21.1 | 11.2 | 22.7 | 16.94 | 23.53 ab |
| Kulai (V40) | 14.1 | 17.6 | 21.7 | 20.4 | 19.0 | 18.0 | 24.4 | 14.8 | 17.5 | 19.4 | 14.3 | 13.3 | 13.5 | 15.5 | 21.24 | 17.37 ef |
| Cabe Berebes (V44) | 20.8 | 25.6 | 21.5 | 24.5 | 23.0 | 14.6 | 19.4 | 17.2 | 22.8 | 21.9 | 15.5 | 26.0 | 12.4 | 23.0 | 14.60 | 20.62 c |
| MC11 (V46) | 17.9 | 15.8 | 24.3 | 19.4 | 17.0 | 17.8 | 17.6 | 15.9 | 21.3 | 15.4 | 14.1 | 24.9 | 12.4 | 15.4 | 23.27 | 17.76 ef |
| Ch.252-C-P (V49) | 18.4 | 24.3 | 24.9 | 27.1 | 27.0 | 18.9 | 24.4 | 18.8 | 30.6 | 19.5 | 18.6 | 24.4 | 20.6 | 26.5 | 17.09 | 23.13 ab |
| Ch 385 (V54) | 21.3 | 24.2 | 26.3 | 25.7 | 32.0 | 20.3 | 25.5 | 21.8 | 29.3 | 22.0 | 19.2 | 19.1 | 13.0 | 24.2 | 15.38 | 23.10 ab |
| Ch387 01110-1(V56) | 15.2 | 19.1 | 26.8 | 19.6 | 17.0 | 18.1 | 23.1 | 13.9 | 22.2 | 17.2 | 14.7 | 24.3 | 12.4 | 12.4 | 24.51 | 18.31 de |
| Ch 388 (V57) | 12.6 | 17.2 | 16.3 | 23.8 | 17.0 | 13.8 | 12.6 | 13.4 | 16.8 | 16.3 | 12.2 | 16.0 | 10.7 | 16.8 | 15.42 | 15.38 g |
| Ch 389 (V58) | 16.2 | 16.4 | 16.7 | 18.6 | 18.0 | 13.3 | 13.8 | 13.4 | 16.8 | 13.2 | 12.1 | 12.8 | 11.8 | 13.9 | 17.31 | 14.73 g |
| Ch 393 (V61) | 15.1 | 19.9 | 17.4 | 21.2 | 17.0 | 20.8 | 15.5 | 21.8 | 18.4 | 23.6 | 11.9 | 17.1 | 11.6 | 17.4 | 19.65 | 17.75 ef |
| MC4 (V63) | 20.3 | 14.6 | 14.5 | 16.3 | 19.0 | 15.8 | 11.3 | 14.0 | 19.1 | 15.9 | 12.9 | 12.7 | 13.7 | 12.7 | 20.68 | 15.21 g |
| India Sanam (V64) | 23 | 22.9 | 19.9 | 24.9 | 29.0 | 29.6 | 19.6 | 19.9 | 24.4 | 29.1 | 20.2 | 19.0 | 20.4 | 11.2 | 23.27 | 22.34 b |
| C.V (%) | 12.7 | 24.3 | 18.8 | 11.5 | 17.0 | 16.4 | 21.4 | 20.4 | 13.3 | 16.3 | 14.1 | 21.7 | 21.9 | 17.6 | 18.31 | 18.3 |
| Environment mean # | 17.0d | 20.3c | 22.2ab | 23.1a | 21.0b | 19.2c | 19.3c | 17.9d | 21.73b | 18.83c | 15.43e | 20.16c | 12.66f | 20.3c | | 19.23 |
| Mean of 2 seasons # | 18.7 c | | 22.3 a | | 20.4 b | | 18.5 c | | 20.5 b | | 17.8 d | | 16.5 e | | | |

JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season; #, ## @ Mean separation in row, column by Duncan's multiple range test, values with similar letters are not significantly different at 5% level.

Table 4.16. Mean values of percentage of bleaching for genotypes grown in different environments

| GENOTYPES (Codes) | CH1 | CH2 | BM1 | BM2 | GM1 | GM2 | JK! | JK2 | LG1 | LG2 | TL1 | TL2 | KD1 | KD2 | C.V (%) | Genotype mean ## |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch 291-P1(V1) | 55.8 | 67.5 | 60.3 | 28.6 | 49.7 | 37.8 | 47.5 | 42 | 37.9 | 42.0 | 64.8 | 86.4 | 56.6 | 56.0 | 36.60 | 52.3 a |
| Ch 254(V9) | 68.3 | 71.8 | 47.7 | 20.7 | 39.9 | 36.0 | 18.3 | 61.1 | 19.8 | 60.7 | 47.4 | 80.7 | 42.9 | 12.1 | 34.00 | 44.8 bc |
| Ch 284-6 (V15) | 57.8 | 66.7 | 51.2 | 30.9 | 50.1 | 13.7 | 15.5 | 57 | 39.8 | 36.1 | 55.3 | 37.2 | 54.9 | 27.7 | 38.60 | 42.4 bcd |
| Purple Chilli (V16) | 30.3 | 22.5 | 32.3 | 8.4 | 51.3 | 14.0 | 4.8 | 42.7 | 22.3 | 27.0 | 53.8 | 42.2 | 35.1 | 36.6 | 48.70 | 29.9 hijk |
| Xian Ch257 (V25) | 38.8 | 32.6 | 33.2 | 22.3 | 52.0 | 14.2 | 28.5 | 54.7 | 16.2 | 21.2 | 56.7 | 41.9 | 34.4 | 32.7 | 42.30 | 34.2 fghi |
| Ch 252-C (V28) | 50.8 | 50.4 | 22.5 | 8.8 | 30.9 | 15.9 | 3.5 | 42.2 | 9.73 | 13.1 | 41.6 | 17.5 | 50.3 | 12.9 | 54.70 | 26.4 jk |
| Ch 286 (V31) | 38.5 | 25.8 | 38.1 | 14.1 | 30.9 | 11.5 | 12.8 | 37.8 | 13.2 | 51.5 | 59.2 | 55.7 | 26.3 | 13.6 | 40.90 | 30.6 ghij |
| Ch 291(V32) | 52.8 | 67.9 | 45.5 | 27.5 | 36.7 | 23.4 | 23.7 | 67.5 | 45.9 | 25.0 | 66.6 | 32.6 | 19.8 | 35.0 | 42.10 | 40.7 cde |
| Hantaka Ch 281(V36) | 40.5 | 53.3 | 38.6 | 12.0 | 41.7 | 12.9 | 13.6 | 38.8 | 9.58 | 27.2 | 65.4 | 29.4 | 33.4 | 15.8 | 44.10 | 30.9 ghij |
| Taiwan dc CK #1T(V38) | 60.8 | 55.3 | 51.8 | 17.0 | 46.4 | 30.0 | 5.78 | 59.0 | 35.8 | 29.7 | 67.6 | 51.8 | 61.8 | 22.6 | 34.30 | 42.5 bcd |
| Huey Sithon (V39) | 27.8 | 20.4 | 12.9 | 15.1 | 24.5 | 3.65 | 2.67 | 27.2 | 14.2 | 21.6 | 33.3 | 62.3 | 41.7 | 28.2 | 49.800 | 23.9 k |
| Kulai (V40) | 65.3 | 51.1 | 51.4 | 36.8 | 45.5 | 24.0 | 36.1 | 46.1 | 30.1 | 50.7 | 51.7 | 59.7 | 39.5 | 51.9 | 45.30 | 45.7 bc |
| Cabe Berebes (V44) | 42.3 | 32.8 | 45.7 | 13.8 | 37.1 | 19.7 | 4.38 | 35.7 | 38.5 | 22.9 | 62.2 | 58.5 | 14.0 | 30.7 | 39.20 | 32.7 ghij |
| MC 11 (V46) | 62.5 | 27.7 | 34.5 | 17.4 | 44.5 | 26.4 | 13.3 | 46.2 | 19.6 | 37.2 | 51.5 | 49.1 | 46.6 | 21.7 | 50.90 | 35.6 efgh |
| Ch 252- C-P (V49) | 19.8 | 10.7 | 21.7 | 13.3 | 9.8 | 12.2 | 8.43 | 41.1 | 2.15 | 3.7 | 32.3 | 17.5 | 19.1 | 12.0 | 89.10 | 16.0 l |
| Ch 385 (V54) | 45.8 | 20.6 | 19.3 | 13.4 | 25.8 | 18.9 | 27.3 | 46.1 | 3.35 | 49.3 | 37.5 | 36.3 | 27.4 | 29.6 | 58.40 | 28.6 ijk |
| Ch387 01110-1(V56) | 42.5 | 45.5 | 28.8 | 13.8 | 44.8 | 21.4 | 10.9 | 37.4 | 14.2 | 36.3 | 64.9 | 40.9 | 29.3 | 29.2 | 53.60 | 32.8 ghij |
| Ch 388 (V57) | 38.0 | 53.7 | 41.3 | 11.1 | 58.7 | 34.2 | 16.6 | 39.3 | 20.1 | 12.7 | 63.8 | 60.3 | 26.9 | 36.4 | 41.40 | 36.9 cdef |
| Ch 389(V58) | 44.0 | 58.4 | 38.8 | 13.3 | 40.5 | 24.5 | 7.5 | 56.3 | 22.6 | 31.7 | 70.6 | 45.9 | 54.7 | 47.7 | 38.00 | 39.7 cdef |
| Ch 393(V61) | 49.5 | 33.4 | 53.2 | 17.6 | 56.3 | 45.2 | 24.6 | 29.3 | 19.3 | 26.4 | 56.6 | 76.3 | 32.2 | 35.0 | 43.30 | 39.6 cdef |
| MC 4 (V63) | 51.5 | 41.4 | 73.4 | 16.2 | 57.7 | 26.0 | 25.6 | 52.6 | 40.6 | 60.9 | 62.7 | 59.6 | 66.2 | 45.4 | 36.50 | 48.6 ab |
| India Sanam (64) | 21.3 | 35.5 | 31.5 | 9.6 | 52.1 | 6.8 | 30.7 | 43.0 | 30.7 | 9.70 | 55.3 | 49.4 | 37.9 | 20.9 | 51.90 | 31.0 ghij |
| C.V (%) | 30.7 | 39.2 | 23.8 | 53.9 | 40.2 | 54.5 | 70.7 | 35.4 | 47.7 | 55.2 | 27.7 | 47.4 | 38.0 | 41.6 | 43.69 | |
| Environment mean # | 45.6bc | 43.0cd | 39.7d | 17.3g | 42.1cd | 21.5fg | 17.4g | 45.5bc | 23.2f | 31.7e | 55.5a | 49.6b | 38.7d | 29.5e | | 35.73 |
| Means of two seasons # | 44.3 b | | 28.5 | | 31.8 c | | 31.5 c | | 27.4 | | 52.54 a | | 34.1 c | | | |

JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season; #, ## @ Mean separation in row, column by Duncan's multiple range test, values with similar letters are not significantly different at 5% level.

Table 4.17. Mean values of light transmission for genotypes grown in different environments

| GENOTYPES (Codes) | CH1 | CH2 | BM1 | BM2 | GM1 | GM2 | JK1 | JK2 | LG1 | LG2 | TL1 | TL2 | KD1 | KD2 | CV (%) | Genotype mean ## |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch 291-P (V1) | 10.9 | 6.2 | 22.0 | 2.4 | 11.6 | 0.8 | 6.6 | 13.9 | 17.3 | 1.5 | 10.0 | 6.6 | 5.9 | 5.9 | 34.42 | 8.7 abc |
| Ch 254 (V9) | 11.2 | 4.6 | 18.7 | 1.1 | 11. 3 | 1.0 | 10.4 | 17.6 | 14.2 | 6.1 | 6.5 | 11.6 | 2.5 | 2.9 | 37.55 | 8.5 abcd |
| Ch 284-6(V15) | 11.3 | 3.6 | 4.2 | 4.3 | 5.8 | 2.4 | 10.2 | 10.9 | 17.9 | 4.2 | 8.3 | 11.7 | 6.1 | 0.5 | 53.37 | 7.2 fghi |
| Purple Chilli (V16) | 9.6 | 2.9 | 7.2 | 2.7 | 9.6 | 3.1 | 10.7 | 13.5 | 14.3 | 2.8 | 5.8 | 7.6 | 3.2 | 1.4 | 38.14 | 6.7 hijkl |
| Ch 257(V25) | 9.9 | 2.2 | 10.6 | 5.6 | 9.6 | 1.9 | 3.91 | 10.0 | 14.6 | 3.0 | 9.2 | 11.6 | 4.2 | 2.2 | 43.10 | 7.0 fghij |
| Ch 252-C (V28) | 10.1 | 5.5 | 17.5 | 17.4 | 11.8 | 2.2 | 10.9 | 13.1 | 14.4 | 3.1 | 10.1 | 4.8 | 8.2 | 3.1 | 28.84 | 9.5 a |
| Ch 286 (V31) | 8.2 | 3.0 | 9.9 | 1.7 | 8.3 | 1.3 | 10.4 | 10.4 | 11.9 | 10.5 | 10.3 | 7.3 | 1.1 | 8.8 | 50.32 | 7.4 efghi |
| Ch 291(V32) | 10.5 | 7.8 | 18.3 | 0.7 | 9.1 | 1.8 | 14.5 | 14.5 | 15.9 | 5.4 | 7.1 | 8.1 | 4.1 | 0.4 | 34.09 | 8.5 abcde |
| Ch 281(V36) | 12.1 | 6.4 | 18.7 | 0.5 | 5.9 | 2.8 | 6.9 | 12.4 | 10.0 | 3.4 | 8.9 | 9.2 | 3.3 | 3.5 | 55.13 | 7.4 defghi |
| Taiwan dc CK #1T(V38) | 14.6 | 7.5 | 12.3 | 2.1 | 11.8 | 4.5 | 12.4 | 17.1 | 16.1 | 4.9 | 9.5 | 12.0 | 4.2 | 3.6 | 36.55 | 9.5 a |
| Huey Si thon (V39) | 9.4 | 3.7 | 13.7 | 3.2 | 5.6 | 2.5 | 2.2 | 9.2 | 10.3 | 3.9 | 3.8 | 4.7 | 4.4 | 2.9 | 54.72 | 5.6 l |
| Kulai (V40) | 15.2 | 1.0 | 10.2 | 3.2 | 9.9 | 0.7 | 6.5 | 12.7 | 11.5 | 11.5 | 8.7 | 11.6 | 5.3 | 2.9 | 36.62 | 7.9 bcdefg |
| Cabe Berebes (V44) | 10.3 | 4.1 | 17.9 | 1.8 | 7.7 | 4.3 | 10.3 | 12.8 | 13.9 | 4.9 | 4.6 | 10.3 | 2.0 | 2.0 | 46.77 | 7.6 cdefgh |
| MC11 (V46) | 14.1 | 14.1 | 18.9 | 2.1 | 7.2 | 7.2 | 12.1 | 12.1 | 13.1 | 6.9 | 7.0 | 8.1 | 5.2 | 3.3 | 32.88 | 9.4 a |
| Ch.252-C-P (V49) | 5.5 | 4.5 | 16.4 | 0.3 | 3.6 | 3.6 | 4.6 | 10.5 | 15.7 | 2.9 | 5.1 | 7.2 | 0.9 | 4.0 | 52.13 | 6.1jkl |
| Ch385 (V54) | 9.0 | 4.3 | 16.3 | 5.1 | 6.8 | 3.5 | 6.0 | 13.2 | 10.4 | 1.1 | 6.9 | 6.0 | 5.1 | 4.3 | 39.70 | 7.0 fghijk |
| Ch387 01110-1(V56) | 9.2 | 2.9 | 6.3 | 5.6 | 5.7 | 0.7 | 3.7 | 14.3 | 16.6 | 6.0 | 9.8 | 3.7 | 2.2 | 2.2 | 49.86 | 6.3 ijkl |
| Ch 388 (V57) | 12.3 | 0.9 | 7.5 | 1.3 | 7.9 | 12.3 | 9.2 | 9.8 | 16.3 | 4.8 | 7.2 | 9.7 | 9.7 | 4.9 | 50.08 | 8.1 bcdef |
| Ch389 (V58) | 10.3 | 3.2 | 16.0 | 10.2 | 7.5 | 5.9 | 11.9 | 11.3 | 12.6 | 12.6 | 7.8 | 6.5 | 5.9 | 3.8 | 41.27 | 9.0 ab |
| Ch393 (V61) | 9.1 | 3.7 | 8.4 | 1.9 | 7.4 | 0.8 | 5.4 | 5.4 | 11.1 | 2.7 | 8.0 | 7.3 | 5.7 | 5.3 | 46.98 | 5.9 kl |
| MC4 (V63) | 12.1 | 5.1 | 12.9 | 10.8 | 10.9 | 0.4 | 10.7 | 8.5 | 14.0 | 6.9 | 6.8 | 8.4 | 7.1 | 43.1 | 38.85 | 8.5 abcde |
| India Sanam (V64) | 7.07 | 3.9 | 13.0 | 1.9 | 2.5 | 1.7 | 8.3 | 8.3 | 22.00 | 2.6 | 7.1 | 12.3 | 3.6 | 1.6 | 31.88 | 6.9 ghijk |
| C.V (%) | 29.27 | 61.35 | 23.23 | 38.58 | 30.57 | 25.61 | 36.38 | 24.01 | 26.71 | 39.93 | 44.78 | 34.99 | 36.34 | 60.81 | 34.73 | 34.73 |
| Environment mean # | 10.54d | 4.59gh | 13.48b | 3.89j | 8.06ef | 2.97j | 8.54e | 11.89c | 14.28a | 5.07g | 7.64f | 8.46e | 4.54gh | 3.34ij | | 7.66 |
| Mean of 2 seasons# | 7.5 | | 8.7 | | 5.5 | | 10.2 | | 9.7 | | 8.0 | | 3.9 | | | |

JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season; #, ## @ Mean separation in row, column by Duncan's multiple range test, values with similar letters are not significantly different at 5% level.

Table 4. 18. Mean values of capsaicin for genotypes grown in different environments

| GENOTYPES (Codes) | CH1 | CH2 | BM1 | BM2 | GM1 | GM2 | JK1 | JK2 | LG1 | LG2 | TL1 | TL2 | KD1 | KD2 | C.V. (%) | Genotype Means## |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch 291 -P (V1) | 5.1 | 4.2 | 10.9 | 9.9 | 7.7 | 9.7 | 5.6 | 4.2 | 8.9 | 11.0 | 5.6 | 6.9 | 7.6 | 7.7 | 20.8 | 7.5 defgh |
| Ch 254 (V9) | 4.05 | 4.36 | 10.0 | 11.7 | 8.3 | 7.2 | 6.6 | 3.4 | 8.0 | 6.9 | 5.8 | 6.5 | 9.2 | 10.0 | 25.4 | 7.4 efgh |
| Ch Ch 284-6 (V15) | 5.5 | 5.5 | 7.6 | 8.1 | 7.4 | 11.9 | 6.1 | 7.0 | 9.0 | 8.0 | 4.7 | 6.0 | 4.9 | 6.3 | 32.3 | 7.0 h |
| Purple Chilli (V16) | 7.1 | 6.5 | 9.2 | 12.7 | 11.4 | 10.9 | 6.2 | 6.1 | 7.4 | 7.9 | 6.8 | 4.7 | 8.0 | 8.2 | 21.8 | 8.1 bcde |
| Xian Ch257 (V25) | 5.3 | 8.1 | 8.5 | 11.8 | 9.6 | 8.4 | 8.5 | 6.5 | 8.7 | 9.0 | 6.5 | 5.9 | 8.4 | 7.8 | 21.0 | 8.1 bcde |
| Ch 252-C (V28) | 5.7 | 5.8 | 9.1 | 12.2 | 6.5 | 9.5 | 7.9 | 5.4 | 8.7 | 9.6 | 6.2 | 6.9 | 8.1 | 9.5 | 21.2 | 7.9 cdefg |
| Ch 286 (V31) | 7.4 | 7.9 | 7.8 | 11.2 | 10.6 | 12. 1 | 7.7 | 6.3 | 9.2 | 8.5 | 5.0 | 7.8 | 7.9 | 9.7 | 20.5 | 8.5 bc |
| Ch291(V32) | 5.1 | 5.5 | 9.0 | 8.8 | 8.5 | 9.2 | 5.9 | 3.9 | 7.1 | 7.5 | 6.9 | 5.9 | 9.4 | 8.2 | 21.8 | 7.2 gh |
| Ch281(V36) | 4.3 | 6.3 | 11.1 | 10.6 | 8.2 | 6.4 | 8.2 | 4.5 | 7.6 | 6.9 | 4.9 | 6.2 | 8.9 | 9.8 | 24.1 | 7.4 defgh |
| Taiwan CK#IT (V38) | 6.2 | 6.1 | 4.7 | 11.1 | 9.0 | 8.6 | 6.7 | 5.3 | 7.7 | 6.7 | 6.7 | 6.9 | 7.6 | 10.7 | 24.0 | 7.4 defgh |
| Huey Si thon (V39) | 6.8 | 7.3 | 10.9 | 10.7 | 9.2 | 15.4 | 8.1 | 6.8 | 7.5 | 8.1 | 7.0 | 7.2 | 7.8 | 9.9 | 24.9 | 8.8 ab |
| Kulai (V40) | 5.5 | 5.1 | 7.4 | 11.8 | 8.5 | 9.8 | 7.0 | 6.3 | 6.9 | 8.2 | 7.5 | 5.8 | 5.6 | 7.7 | 25.5 | 7.4 efgh |
| Cabe Berebes (V44) | 5.2 | 7.0 | 10.8 | 11.1 | 8.8 | 10.7 | 7.1 | 3.9 | 8.1 | 9.1 | 5.9 | 5.0 | 7.7 | 9.7 | 24.8 | 7.9 cdefg |
| MC11 (V46) | 3.8 | 8.3 | 10.3 | 9.3 | 9.9 | 11.7 | 5.0 | 3.4 | 8.6 | 6.9 | 5.3 | 3.7 | 6.5 | 8.2 | 22.9 | 7.2 gh |
| Ch 252- C-P (V49) | 6.8 | 8.9 | 12.1 | 10.9 | 10.2 | 10.0 | 8.2 | 9.2 | 10.9 | 10.1 | 8.0 | 6.5 | 9.7 | 10.3 | 22.0 | 9.4 a |
| Ch 385 (V54) | 7.8 | 7.8 | 10.4 | 9.7 | 10.0 | 8.0 | 8.9 | 5.3 | 10.0 | 6.6 | 9.6 | 8.7 | 8.9 | 7.3 | 24.8 | 8.5 bc |
| Ch387 01110-1 (V56) | 5.6 | 5.2 | 8.9 | 9. 0 | 8.5 | 9.4 | 2.4 | 4.7 | 8.0 | 8.3 | 6.9 | 4.1 | 7.3 | 7.3 | 27.8 | 6.8 h |
| Ch 388 (V57) | 4.9 | 5.4 | 6.4 | 14.7 | 9.4 | 10.3 | 8.6 | 5.0 | 11.1 | 7.2 | 5.4 | 6.9 | 7.9 | 6.1 | 18.5 | 7.8 cdefg |
| Ch 389 (V58) | 5.4 | 5.6 | 5.6 | 13.6 | 7.4 | 11.5 | 5.5 | 2.6 | 7.6 | 5.1 | 6.0 | 7.4 | 6.0 | 6.5 | 24.5 | 6.8 h |
| Ch 393 (V61) | 6.9 | 5.4 | 7.2 | 12.6 | 8.7 | 12.3 | 5.7 | 7.1 | 8.3 | 8.3 | 5.9 | 5.3 | 8.6 | 11.8 | 21.5 | 8.2 bcd |
| MC 4 (V63) | 5.3 | 4.7 | 7.6 | 13.3 | 7.5 | 11.1 | 6.7 | 5.4 | 7.7 | 7.2 | 5.0 | 4.4 | 7.5 | 9.1 | 24.7 | 7.3 fgh |
| India Sanam (V64) | 5.8 | 7.0 | 8.9 | 10.0 | 9.5 | 9.7 | 6.7 | 5.5 | 9.5 | 8.8 | 6.8 | 5.7 | 7.7 | 10.3 | 18.4 | 8.0 cdef |
| C.V (%) | 23.65 | 22.91 | 19.91 | 21.89 | 18.25 | 20.84 | 22.57 | 36.56 | 19.49 | 17.8 | 36.8 | 23.29 | 26.99 | 15.95 | 23.0 | 0 |
| Enviroment mean# | 5.71gh | 6.27fg | 8.85c | 11.08a | 8.85c | 10.18b | 6.79f | 5.39h | 8.48cd | 7.99de | 6.28fg | 6.13g | 7.78e | 8.70c | | 7.80 |
| Means of 2 seasons# | 6.0 d | | 10.3 a | | 9.5 b | | 6.1 d | | 8.2 b | | 6.2 c | | 8.2 b | | | |

JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season; #, ## @ Mean separation in row, column by Duncan's multiple range test, values with similar letters are not significantly different at 5% level.

4.2.3.3. Combined analyses of variance

A combined ANOVA would provide information not only on whether genotype as a whole is a significant source of variation, but also whether environment (season or location) and /or genotype x environment effects are important in causing differences in the traits under study.

Prior to conducting the combined analysis, the error variances among individual environment were tested for homogeneity using Bartlett's method. The details of the test are summarised in Table 4.19. The assumption is that each sample variance is an estimate of the same parametric error variance. Heterogeneous error variance often influences the interpretation and validity of certain tests for significance on variance ratios, usually resulting in more frequent occurrences of significance.

Table 4.19. shows, the $\chi^2$ for traits such as plant height , capsaicin content were less than $\chi^2$ value of 21.3 at probability level of 5%, 1% respectively with df=13. While the $\chi^2$ for traits such as fruit weight, fruit size, fruit number, percentage of bleaching, days to dry, conversion rate, crude fibre, colour (light transmission) and dry weight exceeded $\chi^2$ value of 21.3 at probability level of 5%, 1% respectively with df =13. This means the error variances for plant height and capsaicin content were homogenous but the error variances for fruit weight, fruit size, fruit number, percentage of bleaching, days to dry, conversion rate, crude fibre, colour (light transmission) and dry weight were heterogeneous. One would expect error variances of individual experiments to be different from season to season and from location to location. The heterogeneity of error variances may arise because the seasons used in this study were consecutive and the locations were chosen for diversity of soil factors and climatic factors differing in temperature and rainfall. For instance,

the soil types: mineral soils, acid sulphate, bris and peat were substantially different from each other both in chemical and physical characteristics. However, Hanson (1964) concluded these environments selected in this way should not be biased sample of the environmental populations likely to be encountered. Furthermore, different soil emollient treatment was practised according to respective soil type in order to ensure good crop. Varying pattern of rainfall distribution also could be another source of heterogeneity. In addition there were also cases in which heterogeneity of error variances is a function of an improper choice of measurement scales, so that differences among means bring about heterogeneity of variances.

Regardless of the case may be, the error variances were pooled and combined analyses were conducted on these traits in accordance with Schutz & Bernard (1967) and Fripp and Caten (1971) who worked on untransformed data. Walton (1968) who pointed out that data need not be transformed if genotypes were compared in small related group. The error variances of the separate experiments were heterogeneous; thus the results of the pooled analysis of variance of the traits concerned need to be interpreted with caution. In addition to considering the statistical significance of the various traits, due attention must also be given to the relative magnitudes of the variance components.

Table 4.19. Bartlett's test for homogeneity of error variance over 14 environments

| Characters | $\sum S_i^2$ | $\bar{S}_i^2$ | $\log \bar{S}_i^2$ | $\sum \log S_i^2$ | $\chi^2$ |
|---|---|---|---|---|---|
| Yield (g/plant) | 2836.19 | 202.59 | 2.31 | 13.55 | 360.49** |
| Mean fruit weight (g) | 22.61 | 1.62 | 0.21 | 1.40 | 218.11** |
| Number fruits/plant | 438.00 | 31.29 | 1.50 | 16.54 | 633.28 ** |
| Dry yield (g/plant) | 2391.02 | 170.79 | 2.23 | 13.55 | 2553.03** |
| Plant height | 507.88 | 63.49 | 1.80 | 14.07 | 49.89 ** |
| Days to harvest | 7.26 | 0.52 | 0.29 | 13.80 | 1456.26** |
| Days to dry | 115.11 | 8.22 | 0.91 | 9.81 | 430.89 ** |
| Dry weight (g) | 678.27 | 48.45 | 1.69 | 21.32 | 327.46 ** |
| Conversion rate | 168.47 | 12.03 | 1.08 | 14.44 | 98.09 ** |
| Percentage of bleaching | 3078.31 | 219.67 | 2.34 | 32.03 | 110.06 ** |
| Colour transmission | 99.15 | 7.08 | 0.85 | 10.47 | 206.57 ** |
| Capsaicin content | 73.42 | 5.24 | 0.72 | 7.53 | 368.09 ** |

* @ $\chi^2$ significant at $P \leq 0.01$ (0.01);
$\chi^2 = M/C$, with degree of freedom =k-1; M= 2.3026(df)[ k log $\bar{S}^2$ - $\sum \log S_i^2$] ; C= 1 + [(k +1)/ 3k(df)] with k=14 for all characters except for plant height (k=8) and df @ is degree of freedom for error variance, $S_i^2 = 63$.

4.2.3.3.1. Combined ANOVA over macroenvironments

The combined ANOVA for 22 genotypes in four replications per experiment in 14 environments are given in Table 4.20a. for yield and yield components, mean fruit weight and number of fruits/plant, dry yield, days-to-harvest, plant height and days to dry and quality characters namely conversion rate from fresh to dry, percentage of bleaching reflecting colour retention, light transmission which reflect the colour of the product and capsaicin content. The combined ANOVA over 14 environments showed genotype effects were highly significant at $p < 0.001$ for all the characters. Similarly, effects due to environment and genotype and environment interaction were highly significant. Replicates within environment effects were also highly significant for all characters except for conversion rate.

Significant genotype and environmental effects indicate that all these characters were influenced by genotype and environment of varying magnitudes. The varieties might respond differently in different environments hence giving different relative rankings. Consequently, the performance in one environment is not a reliable predictor of the performance in another. Since all traits tested showed significant genetic effects, therefore there are sufficient variations in all these traits for selection.

Table 4.20a. Mean Square Values for agronomic and quality characters in a combined analysis over 14 environments

| | Source of Variance | | | | |
|---|---|---|---|---|---|
| Traits | Environment (df=13) | Rep (environment) (df=42) | Genotype G (df=21) | GXE (df=273) | Pooled error (df=882) |
| Yield ( g/plant) | 7136689.8*** | 122721.8*** | 232549.2*** | 59285.2*** | 20370.3 |
| No of fruit/plant | 331077.4*** | 6800.4*** | 111733.0*** | 9578.6*** | 3125.5 |
| Mean fruit weight | 222.13*** | 4.52*** | 203.90*** | 7.39*** | 1.61 |
| (g/fruit) | 264269.8*** | 5037.7*** | 4518.2*** | 2186.0*** | 850.8 |
| Dry yield (g/plant) | 24988.5*** | 200.2* | 1664.4*** | 345.4* | 203.6 |
| Days to Harvest | 12687.93*** | 357.59*** | 2357.18*** | 230.98*** | 63.48 |
| Plant Height (cm)# | 725. 99*** | 34.09*** | 31.46*** | 11.93*** | 8.22 |
| Days to Dry | 2784.67*** | 72.36*** | 1992.52*** | 127.19*** | 48.48 |
| Dry weight (g) | 605.58*** | 15.84 ns | 484.14*** | 35.57 *** | 12.41 |
| Conversion rate (%) | 13455.36*** | 973.99*** | 4161.905*** | 4524.01*** | 219.64 |
| % of bleaching | 12111.18*** | 77.17*** | 76.46*** | 32.25*** | 7.0841 |
| | | | | | 3.19 |

*, **, *** @ Significant at probability levels of < 0.05, 0.01, 0.001 respectively
# df @ for environment=13, for rep(Environment)=42, genotype=21, GxE =273 , Error = 882

4.2.3.3.2. Combined ANOVA over locations and planting-seasons

Partitioning further the environment component in the combined ANOVA for each trait into location, planting-season, and location x planting-season provides some insight into the relative importance of these two environmental and their interaction effects. In addition, partitioning the G x E interaction into genotype x location, genotype x planting-season and genotype x location x planting-season will show which G x E component has greater influence over the performance of a trait.

Tables 4.20b showed significant location, planting-season and location x season interaction effects were present for all the traits under study except for number of fruits/plant which showed non-significant effect on planting-season.

Similarly, further partitioning of genotype x environment interaction effect showed significant effects on all traits on components and agronomic due to genotype x location and genotype x planting-season, genotype x location x planting-season except days to harvest and days to dry which showed non significant G x S effect. This is not surprising as days to dry is greatly influenced by handling method (Lease and Lease 1962) while planting-season showed very little effect on days to harvest.

Significant first and second order interactions indicate the necessity for multilocational testing chilli genotypes over a number of seasons and locations in order to characterise genotypic performance more precisely. The effects of replicates within environment were significant for yield, number of fruits/plant, dried yield, plant height, days to dry and capsaicin level.

Table 4.20b. Mean SquareValues for combined ANOVA over locations and planting-season for some chilli traits

| | Source of Variance | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Traits | Location (L) df=6 | Planting - season (S) | LxS df=6 | Rep (Env). df=42 | Genotypes (G) | G x L df=126 | G x S df=21 | G x Lx S df=126 | Pooled Error df=882 |
| Yield ( g/plant) | 6859448.6*** | 1966810.4*** | 8275577.6*** | 122721.8*** | 232549.2*** | 71325.0*** | 31563.4 | 51865.8*** | 20370.3 |
| No of fruit/plant | 220077.6*** | 3646.3 | 496649.0*** | 6800.4*** | 111733.0*** | 10567.0*** | 6506.7** | 9102.2*** | 3125.5 |
| Mean fruit weight (g/fruit) | 449.0*** | 32.1*** | 27.0*** | 4.5 | 203.9*** | 10.1*** | 8.3*** | 4.5*** | 1.62 |
| Dry yield (g/plant) | 261802.9*** | 5690.2** | 309833.3*** | 5037.7*** | 4518.2*** | 2462.2*** | 1580.8* | 2010.7*** | 850.8 |
| Days to Harvest | 47926.0*** | 864.5* | 6071.6*** | 200.2 | 1664.4*** | 360.3*** | 295.2 | 339.0***. | 203.6 |
| Plant Height (cm)# | 18398.4*** | 14636.6*** | 292.6** | 357.6*** | 2357.2*** | 248.2*** | 252.4*** | 185.9*** | 63.5 |
| Days to Dry | 5094.0*** | 460.2*** | 402.3*** | 34.1*** | 31.5*** | 12.9*** | 11.0 | 11.1* | 8.2 |
| Dry weight (g) | 2863.4** | 2560.5*** | 2743.4*** | 72.4 | 1992.5*** | 115.2*** | 162.7*** | 133.3*** | 48.5 |
| Conversion rate (%) | 682.8*** | 496.7*** | 546.5*** | 15.8 | 484.1*** | 32.7*** | 44.8*** | 37.0*** | 12.4 |
| % of bleaching | 15072.2*** | 3613.5*** | 13478.6*** | 974.0 | 4162.0*** | 423.2*** | 345.0* | 498.7*** | 219.7 |
| Light transmission (%) * | 889.0*** | 4537.5*** | 1087.5*** | 77.2 | 76.5*** | 37.1*** | 15.0* | 37.1*** | 7.1 |
| Capsaicin (mg/g) | 322.5*** | 417.6*** | 173.0*** | 5.4** | 24.4*** | 7.1*** | 9.0*** | 6.8*** | 3.2 |

*, **, *** @ Significant at probability levels of $\leq$0.05, 0.01, 0.001 respectively.
# df @ for location=6, planting-season = 1, LxS = 6, for rep(Environment)=42, genotype=21, GxL = 126 ,Gx S=21 , Gx LxS =126 , Error =882
* values given by light transmission at 490 nm wave lenght

#### 4.2.3.4 Variance components

##### 4.2.3.4.1. Variance components over environments

Estimates of variance components for each character as derived from ANOVA over environments are shown in Table 4.21(a). The magnitudes of the variance components determine the relative importance of the effects due to genotypes, environments and their interactions.

Genotypic effects were present in all the characters studied, however, genotype variance was larger in magnitude than environment variance or the genotype x environment for three characters namely mean fruit weight, dry weight and conversion rate. It follows that these traits were strongly controlled by genetic factors and they can be improved through selection. For number of fruits/plant, plant height, percentage of bleaching genetic influence were relatively greater than genetic x environment factors. Genotypic effect contributed the least compared to environmental or environmental x genotypic effects on characters such as yields, dry yield, days-to-harvest, days-to-dry, light transmission and capsaicin.

Environment variance showed greatest influence on yield, number of fruits, dry yield, days to harvest, plant height, days-to-dry, % of bleaching, light transmission and capsaicin content. Environmental influence was also important for mean fruit weight, dry weight and conversion rate.

Genotype x environment effects were present in all characters. Relative to the genotypic effect, genotype x environment has greater effects on both fresh and dry yields, days to harvest, days to dry, light transmission and capsaicin content, implying differential performance for these traits under different environments. For yield and capsaicin, greater genetic x environment influence suggests multi-environmental testing is essential in chilli varietal development.

Table 4.21(a). Variance components and standard error in parenthesis for some chilli characters over different macro-environments

| Varieties | $\sigma^2_G$ (df=21) | $\sigma^2_E$ (df=13) | $\sigma^2_{GE}$ (df=273) | $\sigma^2$ (df=882) | $\sigma^2_P = \sigma^2_G+\sigma^2_{GE}/e+\sigma^2$ |
|---|---|---|---|---|---|
| Yield (g/plant) | 3094.0(1227.88) | 79262.0 (29614.63) | 9728.7(1286.96) | 20370.3 (968.92) | 4152.7 |
| No.of fruits/plant | 1824.2(588.54) | 3611.6 (1373.49) | 1613.3(207.57) | 3125.5 (148.66) | 1995.2 |
| Mean fruit weight (g/fruit) | 3.5 (1.07) | 2.4 (0.92) | 1.4(1.92) | 1.62 (0.08) | 3.6 |
| Dry yield (g/plant) | 41.6(24.02) | 2930.6 (1096.63) | 333.8(47.69 | 850.8 (40.47) | 80.6 |
| Days to harvest | 23.6(8.78) | 280.1 (103.69) | 35.5(7.75) | 203.6 (9.68) | 29.7 |
| Plant height ( cm) | 66.4(12.42) | 138.2(52.66) | 41.87(4.98) | 63.48 (3.02) | 70.6 |
| Days to dry | 0.4(0.17) | 7.8 (3.01) | 0.93 (0.27) | 8.2 (0.39) | 0.6 |
| Dry weight of 200 g fresh (g) | 33.3 (10.49) | 30.20(11.56) | 19.4(2.77) | 49.6 (2.31) | 35.6 |
| Conversion rate (%) * | 8.16(2.55) | 7.46(2.51) | 4. 90(0.77) | 12.0 (0.59) | 8.7 |
| % of bleaching | 66.2 (22.97) | 139.20(56.05) | 58.1(96.49) | 219.6 (10.45) | 74.3 |
| Light transmission (% )** | 0.79 (0.41) | 13.16(50.25) | 6.3(0.692) | 7.1 (0.33) | 1.4 |
| Capsaicin ( mg/g) | 0.31 (0.13) | 2.85(1.08) | 1.0(0.15) | 3.19 (0.15) | 0.4 |

* Dry weight as % of fresh weight; ** @ Light transmission at 490 nm wave length

$\sigma^2_G$ @ Genetic variance, $\sigma^2_E$ @ environmental variance, $\sigma^2_{GE}$ @ genetic and environment interaction

4.2.3.4.2 Variance components over locations and planting-seasons.

Variance component is considered important if the F- test for the corresponding mean square is significant. Estimates of variance components which were computed from the relevant expected mean squares for each characters as derived from the ANOVA over locations and seasons are given in Table.4.21 (b). In general, the magnitude of the variance components was lower when the environment was partitioned into locations and seasons.

Characters such as mean fruit weight, dry weight and conversion rate showed strong genotypic variance relative to environmental variance. Environmental variance was found to be greater than genotypic variance in yield, both fresh and dry, number of fruits, days to harvest, plant height, days to dry, % of bleaching, light transmission and capsaicin content. For yields and number of fruits/plant, the strong environmental effect is mainly due to location x planting-season which contributed about 73% and 45% of total variance respectively. Other traits that showed strong environmental effects mainly through location x planting-season include % of bleaching, light transmission and capsaicin content. In plant height and days-to-harvest the environmental variance is contributed mainly by location effect and interaction between location and season. While capsaicin content, days to dry and bleaching, environmental variance is mainly due to high interaction between location and planting-season effect and location effect in relative to planting-season effect. Interaction between location and planting-season contributed the highest component of environmental variation followed by planting-season effect on light transmission. Relative to G x L x S, genetic effects were greater in fruit number and plant height.

Large G x L x S effects were responsible for larger genotypic x environment interactions in comparison to genotype variance for fresh and dry yields, days to harvest, days taken for fruit to dry, light transmission and capsaicin content. In all these traits, larger genotype x environment interaction were mainly due to genotype x location x planting-season. Genotype x location x planting-season effect and genotype effect were equally important for the expression of percentage of bleaching. In a number of instances, the variance components are negative in value, e.g. $\sigma^2_{gl}$ for percentage of bleaching, dry weight and conversion rate, and $\sigma^2_{gs}$ for plant height, fruit number, yield, percentage of bleaching, days-to-dry, light transmission. This is the consequent of deriving the variance component values by simple arithmetic of the appropriate mean squares. Hence, such variance components may be considered to be essentially zero in values. With regards to yields and number of fruits/plant, the negative values are rather large to be taken as zero. This could be the overall effect of some environmental factors acting antagonistically.

Table. 4.21(b). Variance components and standard error of the estimates in parenthesis for each parameters over locations and planting-seasons

| Traits | $\sigma^2_G$ df G=21 | $\sigma^2_L$ df L=6 | $\sigma^2_S$ df S=1 | $\sigma^2_{LxS}$ df LxS=6 | $\sigma^2_{GL}$ df GL=126 | $\sigma^2_{GS}$ df GS=21 | $\sigma^2_{GSL}$ df GSL=126 | $\sigma^2$ | $\sigma^2_P$* |
|---|---|---|---|---|---|---|---|---|---|
| Yield (g/plant) | 3241.5(1251.36) | -8156.8 (19628.48) | -10208.5(2692.18) | 92288.2(2209.56) | 2432.4(1377.95) | -725.1(405.1) | 7873.9(1638.80) | 20370.3(968.92) | 4515.2 |
| No. of fruit/plant | 1832.2(590.18) | -1579.8(1543.29) | -796.1(403.17) | 5498.5(366.06) | 183.1(217.91) | -92.7(79.67) | 1494.2(286.86) | 3125.5(148.66) | 2021.4 |
| Mean fruit weight (g/fruit) | 3.4 (1.10) | 2.4(1.28) | 0.0 (0.05) | 0.223(0.18) | 0.7 (0.17) | 0.13(0.09) | 0.72(0.14) | 1.6(0.08) | 3.6 |
| Dry yield (g/plant) | 36.7 (26.19) | -275.5(1152.37) | -493.7(251.6) | 3450.4(88.79) | 56.4 (32.24) | -15.4(18.9) | 290.0(63.86) | 850.8(40.43) | 80.7 |
| Days to harvest | 24.1(8.95) | 237.7(137.24 | -8.4(5.06) | 65.2(18.37) | 2.7 (7.73) | -1.6(3.49) | 33.8(10.87) | 203.6(9.69) | 31.1 |
| Plant height (cm) | 67.1( 12.50) | 101.19(52.28) | 8.6(19.4) | 43.3(6.27) | 5.1(4.8) | -2.53(1.81) | 38.67(5.86) | 63.5(3.02) | 71.68 |
| Days to dry | 0.3(0.18) | 3.9(14.52) | 0.1(0.69) | 4.15(1.3) | 0.21(0.26) | -0.00(0.49) | 0.73(0.36) | 8.2(0.39) | 5.66 |
| Dry weight ( 200 g fresh) (g) | 33.0(10.53) | (11.2) | (4.06) | (6.82) | -2.26(2.75) | 1.050(2.78) | 21.203(17.68) | 48.45(2.31) | 35.9 |
| Conversion rate (%) | 8.1(2.56) | 0.206(2.48) | -0.07(0.79) | 7.31(0.98) | -0.54(0.77) | 0.25 (0.13) | 5.23(1.16) | 12.03(0.59) | 8.79 |
| % of bleaching | 69.5(22.03) | 9.48(57.44) | -15.76(11.94) | 138.93(22.47) | -9.43(10.22) | -5.49(4.26) | 69.75(15.80) | 219.65(10.45) | 74.32 |
| Light transmission at 490 nm (%) | 1.2(0.43) | -1.10(3.99) | 5.65(6.08) | 11.13(1.27) | -0.86(0.82) | -0.79(0.23) | 7.5 (1.16) | 7.08(0.34) | 1.88 |
| Capsaicin mg/g | 0.27(0.14) | 0.85(1.04) | 0.39(0.57) | 1.86(3.18) | 0.04(0.15) | 0.08(0.10) | 0.91(0.22) | 3.194(0.15) | 0.44 |

$\sigma^2_G$ @Genetic variance; $\sigma^2_{GL}$@ genetic and location interaction; $\sigma^2_{GS}$ @ genetic and planting-season interaction;
$\sigma^2_{GSL}$ @ genetic and planting-season and location interaction; * $\sigma^2_P=\sigma^2_G + \sigma^2_{GL} + \sigma^2_{GS} + \sigma^2_{GSL} + \sigma^2$

#### 4.2.3. 5. Genotypic coefficients of variation and heritability estimates

From the estimates of variance components, it is possible to calculate the genotypic coefficients of variation and heritability estimate for the various characters. The genotypic coefficient of variation is a measure of genetic variability that exists within a population for a given trait. This together with heritability is important for effective selection. In other words, there must be enough inherent variation in a trait for selection to be possible, and at the same time the trait must be sufficiently heritable to ensure that selected individual will express a genetic advance in the trait.

Table 4.22 (a) presents genotypic, phenotypic variances, genotypic coefficients of variation and the heritability estimates for each character, using the variances derived from ANOVA over macro-environments while Table 4.22(b) presents genotypic, phenotypic variances, genotypic coefficients of variation and the heritability estimates for each character, using the variances derived from ANOVA over locations and planting-seasons.

The two sets of genotypic coefficients of variation (GCV) are similar in terms of magnitude for all the 12 traits under study. Generally, those values estimated from the genotypic variances derived from ANOVA with environments partitioned into locations and crop-seasons in most cases were slightly smaller than those values estimated from ANOVA over macro-environments, especially in characters such as mean fruit size, dry yield, conversion rate and capsaicin content,

The highest genetic variability of more than 40% was recorded for means fruit weight and number of fruit. Moderate amounts of genetic variability (GCV > 10% < 24 %) were found in percentage of bleaching (23.3%), conversion rate (18.4), fruit yield (15.6%), dry weight (18.8%), plant height (14.1%) and light transmission (11.6%) indicating they have sufficient variability for selection.

Characters with the least amount of genetic variability were days to harvest and days taken for the fruit to dry with a GCV of about 5.9% and 3.8%, respectively. The low reading possibly due to very narrow range in the tested populations as regards to these two traits. Traits that recorded 6-10% were dry yield and capsaicin content recorded 9.5 and 7.16% GCV respectively. Similar values were recorded when analysis was conducted over location and planting-season (Table 4.22 (b)).

In estimating heritability (broad sense) for the selection of genotypes, total genetic variance should be used. Thus, denominator includes the total genetic variance as well as the appropriate environmental variance components. In general, both methods of estimating broad sense heritability gave similar ranking. As may be expected, the values using variances derived from ANOVA over macro- environments were larger than those calculated using variances from ANOVA over locations and planting-seasons. They appeared in the same ranking in both sets of heritability determination. Generally the heritability values from ANOVA over macro-environment were bigger in magnitude than heritability from ANOVA over locations and crop-seasons, in general, may be arbitrarily.

For simplicity, heritability estimates were classified into three groups namely high ($h^2 > 0.85$), medium ($h^2 = 0.5 - 0.85$) and low ($h^2 < 0.5$). Six characters were highly heritable, namely mean fruit weight (0.96), dry weight (0.94), conversion rate (0.93), number of fruits (0.91), plant height (0.94) and percentage of *bleaching* (0.89). Nandpuri *et al.* 1971, Jamal Hussain (1977) had reported high heritability for fruit number. The fruit yield recorded comparatively moderate heritability of 0.75 (Table 4.22(a)), light transmission, capsaicin content, days to dry, light transmission and dry yield recorded moderate heritability of 0.64, 0.62, 0.59 and 0.46, respectively (Table 4.22(b)), indicating that these traits have other non hereditary variation as well.

Table.4.22 (a). Genotypic and phenotypic variance, genotypic coefficients of variation and heritability estimates for 12 characters from ANOVA over macro-environments.

| Varieties | $\sigma^2_G$ (df=21) | $\sigma^2_P$ | Heritability= $\sigma^2_G/\sigma^2_P$ | GCV= $\sqrt{\sigma^2_G}$ x 100 / Grand Mean |
|---|---|---|---|---|
| Yield (g/plant) | 3094.00 | 4152.70 | 0.75 | 15.24 |
| No. fruit/plant | 1824.20 | 1995.20 | 0.91 | 42.05 |
| Mean fruit weight (g) | 3.51 | 3.64 | 0.96 | 41.65 |
| Dry yield (g/plant) | 41.60 | 80.60 | 0.52 | 9.45 |
| Days to harvest | 23.60 | 29.74 | 0.79 | 5.90 |
| Plant height (cm) | 66.44 | 70.56 | 0.94 | 14.10 |
| Days to dry | 0.35 | 0.56 | 0.62 | 3.84 |
| Dry weight ( 200 g fresh) (g) | 33.31 | 35.47 | 0.94 | 18.79 |
| Conversion rate (%)* | 8.16 | 8.72 | 0.94 | 18.44 |
| % of bleaching | 66.24 | 74.30 | 0.89 | 22.78 |
| Light transmission at 490 nm (%) | 0.79 | 1.36 | 0.58 | 11.59 |
| Capsaicin mg/g | 0.31 | 0.43 | 0.72 | 7.16 |

$\sigma^2_G$ @ genotypic variance, $\sigma^2_P$ @ Phenotypic variance
* @ Conversion rate = Dry as ratio of fresh weight

Table.4.22 (b). Genotypic and phenotypic variance, genotypic coefficients of variation and heritability estimates for 12 characters from ANOVA over locations and planting-seasons.

| Varieties | $\sigma^2_G$ | $\sigma^2_P$ | Heritability $H^2=\sigma^2_G/\sigma^2_P$ | $VCG = \frac{\sqrt{\sigma^2_G} x100}{\text{Grand Mean}}$ |
|---|---|---|---|---|
| Yield (g/plant) | 3241.5 | 4515.2 | 71.8 | 15.60 |
| Number of fruit/plant | 1832.2 | 2021.4 | 91.7 | 42.14 |
| Mean fruit weight (g) | 3.393 | 3.637 | 93.2 | 41.02 |
| Dry yield (g/plant) | 36.7 | 80.7 | 45.5 | 8.87 |
| Days to harvest | 24.1 | 31.1 | 77.5 | 5.96 |
| Plant height (cm) | 67.06 | 71.68 | 93.6 | 14.15 |
| Days to dry | 0.334 | 0.566 | 59.0 | 3.76 |
| Dry weight ( 200 g fresh) (g) | 32.998 | 35.9 | 91.8 | 18.7 |
| Conversion rate* (%) | 8.08 | 8.79 | 91.9 | 14.78 |
| % of bleaching | 69.508 | 74.32 | 93.5 | 23.3 |
| light transmission at 490 nm (% ) | 1.219 | 1.88 | 64.8 | 14.42 |
| Capsaicin mg/g | 0.269 | 0.436 | 61.7 | 6.69 |

$\sigma^2_G$ @ genotypic variance, $\sigma^2_P$ @ Phenotypic variance, * @ dry as ratio of fresh weight

4.2.3.6 Correlation studies among characters in different environments

The linear correlation coefficients computed for all possible combinations among the parameters of yield components as well as those of quality determinants within each environment are presented in Tables. 4.23.1 to 4.23.11. This analysis would give some indication of the relative effect of the environments on the characters and consequently the influence of these environments on the association between characters.

a) Relationship between yield and other traits

The associations between yield and most of the traits tested except for dry yield, were not consistent both in magnitude and direction across environments (Table 4.23.1). No consistent relationship was observed between yield and days to dry, % of bleaching or light transmission.

Relationship between yield and mean fruit weight was positive with varying strength across environments. This relationship was strongest in Gajah Mati and Cameron Highlands where the environments were favourable. Positive association between yields and yield components namely mean fruit weight and number of fruits/plant exhibited in preliminary trial persistent in multilocational trial. Positive association between fruit yield and mean fruit weight was recorded in 13 out of 14 environment. A more erratic relationship was observed between yield and number of fruit/plant. The association between yield and fruit number was positive in all the environments except in Cameron Highlands (both planting-seasons) and Gajah Mati (GM1) where the relationship appeared negative. Negative correlation between fruit number and yield in Indian chilli was also reported (Arya and Saini 1976).

Very strong positive relationship between yield and dry yield was observed. This is expected since dry yield has direct relationship with fresh yield. Some variation in the magnitude of the association were observed r =-0.72 to 0.90) across environments.

With days to harvest, yield showed very inconsistent relationship. There were variation both in magnitude and direction across environments. Between yield and plant height, positive association was observed in preliminary trials and this persisted in multilocational trial. Significant positive association between yield and plant height were observed in all environments except in Gajah Mati (GM2) and Kundang (KD1) (Table 4.23.5). Thus, plant height could be used as selection criteria to improve yield. No consistent association was established between plant height and other agronomic characters under studied (Table 4.23.5).

As in preliminary trial, yield showed consistent negative correlation with dry weight and conversion rate in 13 out of 14 cases. This implies that varieties with high dry weight or conversion rate may not necessarily be the high yielders. Improvement in yield could be at the expense of conversion rate or vise versa. There was tendency for positive association between yield and percentage of bleaching. Their association appeared to be affected by environment. Yield however, appeared to show no consistent association with days to dry and light transmission. Thus, selection for these characters can be done independent of yield.

Though the relationship between yield and capsaicin (quality character) was inconsistent, there was strong negative relationship in several instances. This implies that simultaneous selection of both characters might not be possible. A similar relationship was detected in yield and protein content of soybean (Mak 1986).

b) Relationship between yield components and other traits

As in preliminary trial, the strong significant negative relationship between mean fruit weight and fruit number was consistently observed in all locations, with Cameron Highlands showing the strongest associations, r=-0.78 and r=0.9. (Table 4.23.2 and Table 4.23.3). Such consistent association between fruit number and mean fruit weight indicates that this association was mainly influenced by genetic factor and only slightly affected by environments. Thus, improvement in fruit number may be at the expense of the size.

Negative correlation between mean fruit weight with parameters such as conversion rate and capsaicin content exibited in preliminary trial persisted in multilocational trial (Tables 4.23.3, 4.23.8, 4.23.9, 4.23.12). Negative association between capsaicin was also reported by Hwang and Lee (1978) and Chew (1984). Positive association between mean fruit weight and percentage of bleaching observed in preliminary trial (Table 4.23.2 and Table 4.23.11) implied that this association was influenced by genetic factors. There was no obvious consistent association observed with light transmission (Table 4.23.10) indicating that the two characters were independent of each other.

Negative association between fruit number with percentage of bleaching in preliminary persisted when the analysis was carried out with data from various locations (Table 4.23.2 and Table 4.23.12). Strong positive association between fruit number with dry weight, conversion rate and capsaicin level also persisted in multilocational trial, with variation between the location greater than variation within the station (Tables 4.23.3, 4.23.7, 4.23.8 and 4.23.11).

c) Relationship between quality characters and other traits

As in preliminary trial, there was strong negative association between conversion rate and percentage of bleaching, and days to dry observed in multilocational trial. Tendency for negative association was also observed between conversion rate and light transmission.

Days to dry showed negative association with conversion rates. Similar relationship was observed in preliminary trial.

The positive association between conversion and capsaicin was not persistent in all the tested locations. There was no consistency in the relationship between conversion rate and the level of the capsaicin. Thus, selection for one is not expected to improve the other. Conversion rate and capsaicin can be selected independently.

Capsaicin content also showed negative correlation with mean fruit weight, percentage of bleaching, days to dry and light transmission (Table 4.23.12). Capsaicin level appeared to increase with decrease values of these parameters. In all the associations, the variation between crop-season was greater than the variation between the location except in Cameron Highlands where both seasons gave similar readings. No obvious variation in Cameron Highlands was observed possibly due to almost negligible temperature difference between the two seasons. Apparently seasonal changes have some affect on the capsaicin level in chilli. Capsaicin also showed positive correlation with dry weight and solid content.

Table 4. 23. 1 Correlation coefficients between yield (g/plant) against other traits by environments

| ENV | Mean fruit weight (g/fruit) | No. of fruits/plant | Dry yield (g/plant) | Days to harvest | Days to dry | Dry weight (g) | Conversion rate % | % of bleaching | Light transmission at 490 nm | Capsaicin content (mg/g) |
|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | 0.33 | 0.49 | 0.88*** | 0.10 | -0.44* | -0.24 | -0.44* | -0.24 | 0.09 | 0.09 |
| JK2 | 0.30 | 0.49* | 0.90*** | -0.35 | -0.46* | 0.09 | 0.09 | 0.20 | 0.10 | 0.10 |
| BM1 | 0.56** | 0.01 | 0.80*** | 0.27 | 0.22 | -0.68** | -0.69*** | 0.67** | 0.08 | -0.45* |
| BM2 | 0.23 | 0.19 | 0.80*** | 0.04 | 0.14 | 0.10 | -0.03 | 0.12 | 0.25 | -0.07 |
| GM1 | 0.72*** | -0.13 | 0.77*** | 0.45* | -0.10 | -0.50* | -0.53** | 0.40 | 0.17 | -0.38 |
| GM2 | 0.75*** | 0.10 | 0.87*** | -0.06 | 0.12 | -0.59*** | -0.65*** | 0.53** | 0.10 | 0.29 |
| CH1 | 0.76*** | -0.53** | 0.72*** | -0.50** | -0.19 | -0.53** | -0.53* | 0.53** | 0.53** | -0.53** |
| CH2 | 0.69*** | -0.22 | 0.81*** | -0.08 | 0.28 | -0.42* | -0.43* | 0.21 | -0.08 | -0.36 |
| LG1 | 0.26 | 0.57** | 0.86*** | 0.31 | 0.39 | -0.21 | -0.10 | -0.11 | -0.28 | 0.07 |
| LG2 | 0.25 | 0.13 | 0.82*** | 0.04 | -0.1 | -0.14 | -0.09 | 0.22 | 0.05 | -0.14 |
| TL1 | 0.38 | 0.28 | 0.87*** | 0.12 | -0.08 | -0.40 | -0.41 | 0.08 | -0.13 | -0.17 |
| TL2 | 0.76*** | 0.03 | 0.72*** | -0.31 | 0.20 | -0.61*** | -0.61*** | 0.52** | -0.04 | 0.19 |
| KD1 | -0.16 | 0.48** | 0.86*** | 0.15 | 0.63*** | -0.44* | -0.49* | -0.58** | -0.63*** | -0.05 |
| KD2 | 0.75*** | 0.51** | 0.89*** | -0.20 | 0.23 | -0.44** | -0.44* | 0.21 | -0.06 | -0.53** |

*,**,*** @ significant level at probability level at 0.05, 0.01, 0.001 respectively ; ENV @ Environments; JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, CH2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season;

Table 4.23.2. Correlation coefficients between mean fruit weight (g/fruit) against other traits by environments

| ENV | Yield (g/plant) | No. of fruit/plant | Dry yield (g/plant) | Days to harvest | Days to dry | Dry weight (g) | Conversion rate (%) | Percentage of bleaching | Light transmission at 490 nm | Capsaicin content (mg/g) |
|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | 0.33 | -0.40 | 0.003 | -0.19 | -0.23 | -0.63*** | -0.59*** | 0.53** | 0.19 | -0.40 |
| JK2 | 0.30 | -0.57** | 0.22 | -0.40 | -0.76*** | -0.11 | -0.10 | 0.20 | -0.21 | 0.07 |
| BM1 | 0.56** | -0.73*** | 0.09 | 0.12 | 0.59*** | -0.84*** | -0.83*** | 0.73*** | -0.12 | -0.44* |
| BM2 | 0.23 | -0.76*** | -0.21 | -0.11 | 0.57** | -0.78*** | -0.68*** | 0.64*** | -0.05 | -0.07 |
| GM1 | 0.72*** | -0.50* | 0.19 | 0.18 | -0.24 | -0.75*** | -0.80*** | 0.54** | 0.12 | -0.44* |
| GM2 | 0.75*** | -0.44* | 0.49* | 0.13 | -0.12 | -0.69*** | -0.68*** | 0.63*** | 0.01 | -0.06 |
| CH1 | 0.76*** | -0.91*** | -0.16 | 0.10 | 0.11 | -0.63*** | -0.62*** | 0.53** | 0.49* | -0.54** |
| CH2 | 0.69*** | -0.78*** | 0.28 | -0.05 | 0.32 | -0.79*** | -0.80*** | 0.61*** | 0.21 | -0.48* |
| LG1 | 0.26 | -0.55** | -0.22 | 0.11 | 0.69*** | -0.89*** | -0.90*** | 0.50* | 0.06 | -0.18 |
| LG2 | 0.25 | -0.60*** | -0.14 | 0.003 | 0.34 | -0.68*** | -0.66*** | 0.57** | 0.59*** | -0.46* |
| TL1 | 0.38 | -0.62*** | -0.09 | 0.10 | 0.02 | -0.89*** | -0.89*** | 0.57*** | 0.21 | -0.48* |
| TL2 | 0.76*** | -0.30 | 0.55* | -0.17 | 0.42* | -0.55** | -0.52** | 0.48* | -0.03 | -0.10 |
| KD1 | -0.66*** | -0.58*** | -0.62** | -0.94*** | -0.79*** | 0.79*** | 0.75*** | 0.83*** | 0.94*** | -0.37 |
| KD2 | 0.75*** | -0.06 | 0.69*** | 0.01 | 0.22 | -0.65*** | -0.51* | 0.45* | -0.02 | -0.67*** |

*,**,*** @ significant level at probability level at 0.05, 0.01, 0.001 respectively ; ENV @ Environments; JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, CH2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season;

Table 4. 23.3 Correlation coefficients between number of fruits/plant against other traits by environments

| ENV | Yield (g/plant) | Mean fruit weight (g/fruit) | Dry yield (g/plant) | Days to harvest | Days to dry | Dry weight (g) | Conversion rate 9%) | % of bleaching | Light transmission at 490 nm | Capsaicin content (mg/g) |
|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | 0.49* | -0.4 | 0.79*** | 0.25 | -0.10 | 0.43* | 0.24 | -0.49* | -0.25 | 0.28 |
| JK2 | 0.49* | -0.57** | 0.52* | 0.20 | -0.11 | -0.09 | 0.23 | -0.09 | -0.11 | 0.02 |
| BM1 | 0.01 | -0.73*** | 0.43* | 0.16 | -0.44* | 0.69*** | 0.54** | -0.50* | 0.19 | 0.24 |
| BM2 | 0.19 | -0.76*** | 0.59** | 0.38 | -0.41 | 0.82*** | 0.70*** | -0.56** | 0.26 | 0.10 |
| GM1 | -0.13 | -0.50* | 0.12 | 0.18 | 0.21 | 0.22 | 0.33 | -0.37 | -0.11 | 0.17 |
| GM2 | 0.10 | -0.45* | 0.19 | -0.22 | 0.39 | 0.15 | 0.02 | -0.27 | 0.05 | 0.34 |
| CH1 | -0.53** | -0.91*** | 0.22 | -0.08 | 0.01 | 0.59*** | 0.62*** | -0.45* | -0.45* | 0.58** |
| CH2 | -0.22 | -0.77*** | 0.15 | -0.02 | -0.29 | 0.79*** | 0.75*** | -0.74*** | -0.28 | 0.53** |
| LG1 | 0.57** | -0.56** | 0.86** | 0.12 | -0.31 | 0.60*** | 0.68*** | -0.58** | -0.23 | 0.36 |
| LG2 | 0.13 | -0.60*** | 0.30 | 0.12 | -0.28 | 0.33 | 0.32 | 0.49* | -0.29 | 0.36 |
| TL1 | 0.33 | -0.62*** | 0.58* | -0.05 | -0.07 | 0.48* | 0.48* | -0.31 | 0.24 | 0.04 |
| TL2 | 0.03 | -0.30 | 0.15 | -0.03 | -0.51* | 0.12 | 0.13 | -0.32 | -0.17 | 0.50* |
| KD1 | 0.72*** | -0.58*** | 0.75*** | 0.11 | -0.31 | 0.40 | 0.42* | -0.18 | -0.52 | 0.22 |
| KD2 | 0.51** | -0.06 | 0.54 | -0.13 | -0.13 | 0.03 | 0.04 | -0.25 | 0.08 | 0.02 |

*,**,*** @ significant level at probability level at 0.05, 0.01, 0.001 respectively ; ENV @ Environments; JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, CH2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season;

Table 4.23.4 Correlation coefficients between dry yield and other traits by environments

| ENV | Yield (g/plant) | Mean fruit wight (g/fruit) | No. of fruits/plant | Days to harvest | Days to dry | Dry weight (g) | Conversion rate (%) | % of bleaching | Light transmission at 490 nm | Capsaicin content (mg/g) |
|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | 0.88*** | 0.003 | 0.79*** | 0.27 | -0.24 | 0.05 | 0.06 | -0.44 | -0.16 | 0.01 |
| JK2 | 0.90*** | 0.23 | 0.52* | -0.25 | -0.43 | 0.49* | 0.49* | 0.41 | 0.21 | -0.25 |
| BM1 | 0.80*** | 0.09 | 0.43* | 0.17 | -0.18 | -0.15 | -0.19 | 0.24 | 0.08 | -0.29 |
| BM2 | 0.80*** | -0.21 | 0.59** | 0.28 | -0.04 | 0.57 | 0.57 | -0.15 | 0.24 | -0.19 |
| GM1 | 0.77*** | 0.19 | 0.12 | 0.44 | -0.02 | 0.11 | 0.11 | 0.05 | -0.04 | -0.02 |
| GM2 | 0.87*** | 0.49* | 0.19 | -0.29 | 0.11 | -0.23 | -0.23 | 0.37 | -0.13 | 0.40 |
| CH1 | 0.72*** | 0.33 | -0.12 | -0.17 | -0.08 | 0.09 | 0.09 | 0.36 | 0.46* | -0.17 |
| CH2 | 0.81*** | 0.28 | 0.15 | -0.31 | 0.13 | 0.15 | 0.15 | -0.14 | -0.23 | -0.04 |
| LG1 | 0.86*** | -0.22 | 0.86** | 0.21 | 0.03 | 0.40 | 0.40 | -0.42 | -0.30 | 0.24 |
| LG2 | 0.82*** | -0.14 | 0.30 | 0.06 | -0.33 | 0.48 | 0.48 | 0.01 | -0.12 | 0.13 |
| TL1 | 0.87*** | -0.09 | 0.58* | 0.07 | -0.07 | 0.09 | 0.09 | -0.17 | -0.06 | -0.01 |
| TL2 | 0.86*** | 0.55* | 0.72*** | 0.87*** | -0.37 | 0.09 | 0.08 | 0.41 | -0.12 | 0.13 |
| KD1 | 0.86*** | -0.25 | 0.59** | 0.02 | 0.04 | 0.53 | 0.62 | 0.09 | -0.19 | -0.10 |
| KD2 | 0.89*** | 0.69*** | 0.54 | -0.10 | -0.01 | -0.07 | -0.06 | -0.05 | -0.06 | -0.46* |

*,**,*** @ significant level at probability level at 0.05, 0.01, 0.001 respectively ; ENV @ Environments; JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, CH2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season;

Table 4.23.5. Correlation coefficients between plant height and other traits by environments

| ENV | Yield (g/plt) | Mean fruit weight (g/plant) | No.of fruits/ plt | Dry yield (g/plant) | Day to harvest | Days to dry | Dry weight (%) | Conversion rate (%) | Days to dry | % bleaching | Light transmission at 490 nm | Capsaicin content (mg/g DWt) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | 0.23 | 0.17 | 0.21 | 0.21 | 0.28* | 0.14 | -0.09 | -0.21 | 0.14 | -0.16 | 0.29 | -0.19 |
| JK2 | 0.27* | 0.33* | 0.08 | 0.31 | 0.27* | -0.26 | -0.27* | 0.14 | -0.26 | -0.27 | -0.23 | -0.37* |
| GM1 | 0.34* | 0.36* | -0.03 | 0.12 | -0.80** | 0.16 | -0.36 | -0.36 | 0.16 | 0.12 | -0.20 | -0.21 |
| GM2 | 0.52* | 0.21 | 0.52** | 0.44* | -0.15 | 0.55** | -0.44* | -0.34 | 0.55** | 0.11 | 0.34* | 0.22 |
| CH2 | -0.03 | 0.69*** | -0.22 | -0.12 | 0.41 | -0.13 | -0.08 | -0.08 | -0.13 | -0.31 | 0.21 | 0.12 |
| LG2 | 0.17 | 0.27* | 0.12 | 0.01 | 0.27* | 0.15 | -0.15 | -0.25 | 0.146 | 0.27* | 0.41 | -0.09 |
| KD1 | -0.55** | 0.65** | -0.44 * | -0.54** | -0.82** | -0.78** | 0.23 | 0.69*** | -0.78*** | -0.82** | 0.77** | -0.31* |
| KD2 | 0.27* | 0.27* | 0.14* | 0.03 | -0.03 | 0.22 | -0.52* | -0.47* | 0.22 | -0.03 | 0.02 | -0.30 |

*,**,*** @ significant level at probability level at 0.05, 0.01, 0.001 respectively ; ENV @ Environments; JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, CH2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season;

Table 4.23.6. Correlation coefficients between days to harvest and other traits by environments

| ENV | Yield (g/plant) | Mean fruitt weight | No. of fruits/plant | Dry yield (g/plant) | Days to dry | Dry weight (g) | Conversion rate (%) | % of bleaching | Light transmission at 490 nm | Capsaicin content (mg/g) |
|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | -0.19 | -0.19 | 0.25 | 0.27 | 0.07 | 0.27 | 0.27 | -0.33 | -0.04 | -0.06 |
| JK2 | -0.40 | -0.40 | 0.20 | -0.25 | 0.43 | -0.25 | 0.17 | -0.40 | 0.05 | -0.36 |
| BM1 | 0.27 | 0.12 | 0.16 | 0.17 | 0.11 | -0.26 | -0.20 | 0.22 | 0.01 | -0.11 |
| BM2 | -0.11 | -0.11 | 0.38 | 0.28 | 0.05 | 0.28 | 0.39 | -0.15 | 0.18 | 0.80 |
| GM1 | 0.18 | 0.18 | 0.18 | 0.44 | 0.03 | 0.44 | -0.21 | 0.19 | 0.09 | 0.60 |
| GM2 | 0.13 | 0.13 | -0.22 | -0.29 | 0.02 | -0.29 | -0.33 | 0.36 | 0.37 | -0.18 |
| CH1 | 0.10 | 0.10 | -0.08 | -0.11 | 0.38 | -0.03 | 0.03 | 0.14 | 0.20 | 0.30 |
| CH2 | -0.05 | -0.05 | -0.02 | -0.31 | 0.38 | -0.11 | 0.11 | 0.12 | 0.24 | -0.10 |
| LG1 | 0.11 | 0.11 | 0.12 | 0.21 | 0.23 | 0.21 | -0.18 | 0.26 | -0.03 | -0.03 |
| LG2 | 0.003 | 0.003 | 0.12 | 0.06 | -0.03 | 0.06 | -0.03 | -0.25 | 0.21 | -0.10 |
| TL1 | 0.10 | 0.10 | -0.05 | 0.07 | -0.02 | 0.07 | -0.09 | -0.21 | 0.09 | 0.03 |
| TL2 | -0.31 | -0.32 | 0.31 | 0.23 | -0.11 | 0.24 | 0.24 | -0.03 | 0.06 | -0.17 |
| KD1 | -0.94*** | -0.94*** | -0.94 | 0.66*** | 0.59** | 0.02 | -0.89*** | -0.89 | -0.96 | 0.32 |
| KD2 | 0.01 | 0.01 | -0.13 | -0.10 | 0.02 | -0.10 | 0.11 | -0.67 | 0.21 | 0.18 |

*,**,*** @ significant level at probability level at 0.05, 0.01, 0.001 respectively ; ENV @ Environments; JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, CH2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season;

Table 4.23.7 Correlation coefficients between days to dry and other traits by environments

| ENV | Yield (g/plant) | Mean fruit weight | No. of fruits/plant | Dry yield (g/plant) | Days to harvest | Dry weight (g) | Conversion rate (%) | % of bleaching | Light transmission at 490nm | Capsaicin content (mg/g) |
|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | -0.26 | -0.23 | -0.10 | -0.24 | 0.07 | -0.07 | -0.10 | 0.03 | 0.22 | -0.09 |
| JK2 | -0.46* | -0.76 | 0.25 | -0.43 | 0.43 | -0.40 | -0.07 | -0.40 | 0.28 | -0.25 |
| BM1 | 0.22 | 0.59*** | -0.45* | -0.18 | 0.11 | -0.61*** | -0.60*** | 0.46* | -0.19 | -0.52** |
| BM2 | 0.14 | 0.57** | -0.41 | -0.04 | 0.05 | -0.34 | -0.23 | 0.49* | -0.23 | -0.08 |
| GM1 | -0.10 | -0.24 | 0.21 | -0.02 | 0.03 | 0.11 | 0.13 | -0.54** | 0.15 | 0.15 |
| GM2 | 0.13 | -0.12 | 0.39 | 0.11 | 0.02 | -0.10 | -0.19 | 0.05 | 0.19 | 0.02 |
| CH1 | -0.12 | 0.11 | 0.01 | -0.27 | 0.38 | -0.10 | -0.04 | 0.18 | 0.06 | 0.33 |
| CH2 | 0.28 | 0.32 | -0.29 | -0.10 | 0.38 | -0.40 | -0.36 | 0.42 | 0.08 | -0.43* |
| LG1 | 0.39 | 0.69*** | -0.31 | 0.03 | 0.23 | -0.68*** | -0.64*** | 0.32 | -0.11 | -0.23 |
| LG2 | -0.10 | 0.34 | -0.28 | -0.33 | -0.03 | -0.51** | -0.48* | 0.04 | -0.01 | -0.21 |
| TL1 | -0.08 | 0.02 | 0.04 | -0.07 | -0.02 | 0.01 | 0.01 | 0.06 | 0.03 | -0.03 |
| TL2 | 0.20 | 0.42* | -0.51* | -0.37 | 0.88 | -0.21 | -0.20 | 0.45* | -0.00 | -0.18 |
| KD1 | 0.63*** | -0.79*** | 0.37 | -0.13 | 0.59** | -0.55** | -0.77*** | -0.79*** | -0.81*** | 0.13 |
| KD2 | 0.23 | 0.22 | -0.13 | -0.01 | 0.02 | -0.55** | -0.39 | 0.49* | 0.04 | -0.14 |

*,**,*** @ significant level at probability level at 0.05, 0.01, 0.001 respectively ; ENV @ Environments; JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, CH2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season;

Table 4.23.8. Correlation coefficients between dry weight against other traits by environments

| ENV | Yield (g/plant) | Mean fruit weight (g/fruit) | No. of fruits/plant | Dry yield (g/plant) | Days to harvest | Days to dry | Conversion rate (%) | % of bleaching | Light transmission at 490 nm | Capsaicin content (mg/g) |
|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | -0.24 | -0.63*** | 0.43* | 0.05 | 0.27 | -0.07 | 0.95*** | -0.28 | -0.36 | 0.37 |
| JK2 | 0.09 | 0.20 | -0.09 | 0.49* | -0.25 | -0.40 | 0.99** | 0.53* | 0.32 | -0.07 |
| BM1 | -0.68** | -0.84*** | 0.69*** | -0.15 | -0.26 | -0.61*** | 0.98*** | -0.82*** | -0.01 | 0.44* |
| BM2 | 0.10 | -0.78*** | 0.82*** | 0.57 | 0.28 | -0.34 | 0.85*** | -0.28 | 0.04 | -020 |
| GM1 | -0.50* | -0.75*** | 0.22 | 0.11 | -0.20 | 0.12 | 0.98*** | -0.56** | -0.34 | 0.47 |
| GM2 | -0.59*** | -0.69*** | 0.15 | -0.23 | -0.29 | -0.10 | 0.85*** | -0.55** | -0.34 | -0.02 |
| CH1 | -0.53** | -0.63*** | 0.59*** | 0.09 | -0.03 | -0.10 | 0.99*** | -0.33 | -0.30 | 0.33 |
| CH2 | -0.42* | -0.79*** | 0.79*** | 0.15 | -0.11 | -0.40 | 0.99*** | -0.67** | -0.23 | 0.62** |
| LG1 | -0.21 | -0.89*** | 0.60*** | 0.40 | 0.21 | -0.68*** | 0.96*** | -0.67** | -0.13 | 0.39 |
| LG2 | -0.14 | -0.68*** | 0.33 | 0.48 | 0.06 | -0.51** | 0.86*** | -0.27 | -0.29 | 0.48* |
| TL1 | -0.40 | -0.89*** | 0.54** | 0.09 | 0.07 | 0.01 | 0.99*** | -0.48* | 0.19 | 0.37 |
| TL2 | -0.61*** | -0.55** | 0.12 | 0.09 | 0.24 | -0.20 | 0.97*** | -0.38 | -0.06 | -0.11 |
| KD1 | -0.44* | 0.79*** | -0.23 | 0.53 | 0.02 | -0.55** | 0.64*** | -0.19 | -0.55 | 0.24 |
| KD2 | -0.44** | -0.65*** | 0.03 | -0.07 | -0.10 | -0.55** | 0.89*** | -0.67*** | 0.06 | 0.35 |

*,**,*** @ significant level at probability level at 0.05, 0.01, 0.001 respectively ; ENV @ Environments; JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, CH2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season;

Table 4.23.9. Correlation coefficients between conversion rate against other traits by environments

| ENV | Yield (g/plant) | Mean fruit weight (g/plant) | No. of fruits/plant | Dry yield (g/plant) | Days to harvest | Days to dry | Dry weight (g) | % of bleaching | Light transmission at 490 nm | Capsaicin content (mg/g) |
|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | -0.37 | -0.63*** | 0.43 | 0.06 | 0.26 | -0.08 | 0.99*** | -0.29 | -0.36 | 0.40 |
| JK2 | 0.14 | -0.11 | 0.24 | 0.09 | 0.17 | -0.22 | 0.99*** | 0.53** | 0.32 | -0.07 |
| BM1 | -0.69*** | -0.87*** | 0.53** | -0.19 | -0.31 | -0.60*** | 0.98*** | -0.81*** | -0.01 | 0.42* |
| BM2 | -0.03 | -0.68*** | 0.70*** | 0.57** | 0.39 | -0.23 | 0.85*** | -0.28 | 0.00 | -0.20 |
| GM1 | -0.53** | -0.80*** | -0.53** | 0.11 | -0.21 | 0.12 | 0.98*** | -0.56** | -0.34 | 0.69*** |
| GM2 | -0.65*** | -0.68*** | 0.02 | -0.23 | -0.33 | -0.19 | 0.85*** | -0.55** | -0.34 | -0.02 |
| CH1 | -0.48* | -0.62*** | 0.62*** | -0.39 | -0.11 | -0.04 | 0.98*** | -0.26 | -0.25 | 0.35 |
| CH2 | -0.43* | -0.80*** | 0.75*** | 0.15 | 0.04 | -0.36 | 0.97*** | -0.67*** | -0.23 | 0.69*** |
| LG1 | -0.10 | -0.90*** | 0.67*** | 0.40 | -0.18 | -0.64*** | 0.96*** | -0.67*** | -0.13 | 0.39 |
| LG2 | -0.09 | -0.66*** | 0.32 | 0.48 | -0.03 | -0.48* | 0.86*** | -0.27 | -0.29 | 0.48* |
| TL1 | -0.41 | -0.89*** | 0.53** | 0.09 | -0.09 | 0.01 | 0.99*** | -0.48* | -0.03 | 0.37 |
| TL2 | -0.61*** | -0.52** | 0.12 | -0.84*** | -0.24 | -0.20 | 0.97*** | -0.38 | -0.06 | -0.11 |
| KD1 | -0.49* | 0.75*** | -0.28 | -0.58** | 0.19 | -0.23 | 0.92*** | -0.19 | -0.55** | 0.24 |
| KD2 | -0.44* | -0.51* | 0.04 | -0.07 | 0.11 | -0.39 | 0.89*** | -0.67*** | 0.00 | 0.35 |

*,**,*** @ significant level at probability level at 0.05, 0.01, 0.001 respectively ; ENV @ Environments; JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, CH2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season;

Table 4.23.10. Correlation coefficients between percentage of bleaching against other traits by environments

| ENV | Yield (g/plant) | Mean fruit weight (g) | No of fruits/plant | Dry yield (g/plant) | Days to harvest | Days to dry | Dry weight (g) | Conversion rate (%) | Light transmission at 490 nm | Capsaicin content (mg/g) |
|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | -0.24 | 0.53** | -0.49* | -0.44 | -0.33 | 0.03 | -0.28 | -0.29 | -0.20 | -0.03 |
| JK2 | 0.20 | 0.20 | -0.09 | 0.41 | -0.40 | -0.40 | 0.53* | 0.53** | 0.49* | 0.49* |
| BM1 | 0.67** | 0.73*** | -0.50* | 0.24 | 0.22 | 0.46* | -0.82*** | -0.81*** | -0.04 | 0.40 |
| BM2 | 0.12 | 0.64*** | -0.56** | -0.15 | -0.15 | 0.49* | -0.28 | -0.28 | -0.19 | -0.35 |
| GM1 | 0.40 | 0.54** | -0.37 | 0.05 | 0.19 | -0.54** | -0.56** | -0.56** | 0.27 | -0.54** |
| GM2 | 0.53** | 0.63*** | -0.27 | 0.37 | 0.36 | 0.05 | -0.55** | -0.55** | 0.13 | -0.16 |
| CH1 | 0.53** | 0.53** | -0.45* | 0.36 | 0.14 | 0.18 | -0.33 | -0.26 | 0.76*** | -0.64* |
| CH2 | 0.21 | 0.61*** | -0.74*** | -0.14 | 0.12 | 0.42 | -0.67** | -0.67*** | 0.03 | -0.71*** |
| LG1 | -0.11 | 0.50* | -0.58** | -0.42 | 0.26 | 0.32 | -0.67** | -0.67*** | 0.45 | -0.40 |
| LG2 | 0.22 | 0.57** | 0.49* | 0.01 | -0.25 | 0.04 | -0.27 | -0.27 | 0.42* | -0.14 |
| TL1 | 0.08 | 0.57*** | -0.31 | -0.17 | -0.21 | 0.06 | -0.48* | -0.48* | 0.23 | -0.53** |
| TL2 | 0.52** | 0.48* | -0.32 | 0.41 | -0.03 | 0.45* | -0.38 | -0.38 | 0.19 | -0.03 |
| KD1 | -0.58** | 0.83*** | -0.18 | 0.09 | -0.89 | -0.79*** | -0.19 | -0.19 | 0.48 | -0.40 |
| KD2 | 0.21 | 0.45* | -0.25 | -0.05 | -0.67 | 0.49* | -0.67*** | -0.67*** | -0.00 | -0.50* |

*,**,*** @ significant level at probability level at 0.05, 0.01, 0.001 respectively ; ENV @ Environments; JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, CH2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season; TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting-season, 2nd planting-season;

Table 4.23.11. Correlation coefficients between light transmission and other traits by environments

| ENV | Yield (g/plant) | Mean fruit weight (g/fruit) | No. of fruits/plant | Dry yield (g/plant) | Days to harvest | Days to dry | Dry weight (g) | Conversion rate (%) | % of bleaching (%) | Capsaicin content (mg/g) |
|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | 0.09 | 0.19 | -0.25 | -0.16 | -0.04 | 0.22 | -0.36 | -0.36 | -0.2 | -0.15 |
| JK2 | 0.10 | -0.21 | -0.11 | 0.21 | 0.05 | 0.28 | 0.32 | 0.32 | 0.49* | -0.08 |
| BM1 | 0.08 | -0.12 | 0.19 | 0.08 | 0.01 | -0.19 | -0.01 | -0.01 | -0.04 | 0.55** |
| BM2 | 0.25 | -0.05 | 0.26 | 0.24 | 0.18 | -0.23 | 0.04 | 0.00 | -0.19 | 0.29 |
| GM1 | 0.17 | 0.12 | -0.11 | -0.04 | 0.09 | 0.15 | -0.34 | -0.34 | 0.27 | -0.49* |
| GM2 | 0.10 | 0.01 | 0.05 | -0.13 | 0.37 | 0.19 | -0.34 | -0.34 | 0.13 | 0.07 |
| CH1 | 0.53** | 0.49* | -0.45* | 0.46* | 0.20 | 0.06 | -0..30 | -0.25 | 0.76*** | -0.54** |
| CH2 | -0.08 | 0.21 | -0.28 | -0.23 | 0.24 | 0.08 | -0.23 | -0.23 | 0.03 | -0.01 |
| LG1 | -0.28 | 0.06 | -0.23 | -0.30 | -0.03 | -0.11 | -0.13 | -0.13 | 0.45 | 0.32 |
| LG2 | 0.05 | 0.59*** | -0.29 | -0.12 | 0.21 | -0.01 | -0.29 | -0.29 | 0.42* | -0.14 |
| TL1 | -0.13 | 0.21 | 0.24 | -0.06 | 0.09 | 0.03 | 0.19 | -0.03 | 0.23 | -0.27 |
| TL2 | -0.04 | -0.03 | -0.17 | -0.12 | 0.06 | -0.00 | -0.06 | -0.06 | 0.19 | -0.11 |
| KD1 | -0.63*** | 0.94*** | -0.52 | -0.19 | -0.96 | -0.81*** | -0.55 | -0.55** | 0.48 | -0.40 |
| KD2 | -0.06 | -0.02 | 0.08 | -0.06 | 0.21 | 0.04 | 0.06 | 0.00 | 0.00 | 0.17 |

*,**,*** @ significant level at probability level at 0.05, 0.01, 0.001 respectively ; ENV @ Environments; JK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season; BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season; CH1, CH2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season;

Table 4.23.12. Correlation coefficients between capsaicin content and other traits by environments

| Envs | Yield (g/plant) | Mean fruit weight (g/fruit) | No. of fruit/plant | Dry yield (g/plant) | Days to harvest | Days to dry | Dry weight (%) | Conversion rate (%) | % of bleaching | Light transmission at 490 nm |
|---|---|---|---|---|---|---|---|---|---|---|
| JK1 | 0.09 | -0.40 | 0.29 | 0.01 | -0.06 | -0.09 | 0.34 | 0.22 | -0.03 | -0.15 |
| JK2 | 0.1 | 0.07 | 0.02 | -0.25 | -0.36 | -0.25 | 0.49* | 0.32 | 0.49* | -0.08 |
| BM1 | -0.45* | 0.44* | 0.24 | -0.29 | -0.11 | -0.52** | 0.39 | 0.44* | 0.4 | 0.55** |
| BM2 | -0.07 | -0.07 | 0.1 | -0.19 | 0.8 | -0.08 | 0.05 | -0.2 | -0.35 | 0.29 |
| GM1 | -0.38 | -0.44* | 0.17 | -0.02 | 0.6 | 0.15 | 0.71*** | 0.69*** | -0.54** | -0.49* |
| GM1 | 0.29 | -0.06 | 0.34 | 0.4 | -0.18 | 0.02 | 0.7 | -0.02 | -0.16 | 0.07 |
| CH1 | -0.53** | -0.54 ** | 0.58 ** | -0.17 | 0.3 | 0.33 | 0.33 | 0.35 | -0.64* | -0.54** |
| CH2 | -0.36 | -0.45* | 0.53** | -0.04 | -0.1 | -0.43* | 0.67*** | 0.69*** | -0.71*** | -0.01 |
| LG1 | 0.07 | -0.18ns | 0.36 | 0.24 | -0.03 | -0.23 | 0.42 * | 0.39 | -0.4 | 0.32 |
| LG2 | -0.14 | -0.46* | 0.36 | 0.13 | -0.1 | -0.21 | 0.52 ** | 0.48 * | -0.14 | -0.14 |
| TL1 | -0.17 | -0.48* | 0.27 | -0.01 | 0.03 | -0.03 | 0.38 | 0.37 | -0.53** | -0.27 |
| TL2 | 0.19 | -0.1 | 0.50 * | 0.13 | -0.17 | -0.18 | -0.08 | -0.12 | -0.03 | -0.11 |
| KD1 | -0.05 | -0.37 | 0.33 | -0.1 | 0.32 | 0.13 | -0.17 | 0.21 | -0.40 | -0.4 |
| KD2 | -0.53** | -0.67*** | 0.02 | -0.46* | 0.18 | -0.14 | 0.48* | 0.35 | -0.50 * | 0.17 |

*,**,*** @ significant at probability level ≤ 0.05, 0.01, 0.001 respectivelyJK1, JK2 @Jalan Kebun 1st planting-season, 2nd planting- season;
BM1, BM2@Bertam 1st planting-season, 2nd planting-season; GM1, GM2 @Gajah Mati 1st planting-season, 2nd planting season;
CH1, H2 @Cameron Highlands 1st planting-season, 2nd planting- season; LG1, LG2 @ Kuala Linggi 1st planting-season, 2nd planting-season;
TL1,TL2@Telong 1st planting-season, 2nd planting-season; KD1, KD2 @Kundang 1st planting- season, 2nd planting-season;

### 4.3. Estimates of stability parameters

Significant G-E interaction effects indicate that the genotypes differed in pattern of response relative to each other in various environments. In such cases, the performance and selection of such genotypes has to be evaluated in terms of its stability over the various environments. Three types of stability had been reported. A genotype is considered stable if among environment variance is small (Type I or biological stability). The regression coefficient associated with Type I stability is $b_i$=0 (Finlay and Wilkinson,1963). Type I is useful in restricted environments since it is dependent on environment under which the experiment is conducted. A genotype is considered stable if its response to environments is parallel to the mean response of all genotypes in the trial (Type 11 of Lin *et al.* (1986) or Agronomic Concept of Becker (1981)). The statistic associated with Type II is $b_i$ = 1 (Finlay and Wilkinson 1963). Type II is a relative measure depending on the genotype included in the test set. Here, all the variances obtained were heterogeneous (Table 4.20) and the estimates of $b_i$'s would have different precision thus making comparison among $b_i$ s rather difficult. In this situation, a second stability parameter $\delta^2_i$ (squared of deviations from regression) is suggested (Eberhart and Russell 1966) in addition to $b_i$. This leads to Type III stability. In Type III, a genotype is considered to be stable if the residual mean squares (MS) from the regression model on the index is small.

Three methods namely group-clustering method of Francis and Kennenberg (1978), the regression and stability variance of Eberhart and Russell (1966) and the non-parametric method of Kang (1991a) were used in the analyses of the G x E to establish the relative stability of the genotypes.

*4.3.1 Genotype grouping based on mean and C.V. of genotypes.*

This technique distinguished Type 1 stability. The genotype-grouping technique (Francis and Kennenberg, 1978) which subdivides the genotypes under studied into four groups based on their means and coefficient of variation (C.V.).

These four groups are:

High mean values and low CV - Group I

High mean values and high CV - Group II

Low mean values and low CV - Group III

Low mean values and high CV - Group IV

Francis and Kennenberg (1978) defined a stable genotype as one with high and consistent mean across environments. Thus, genotypes in Group I are considered most desirable having high mean values and relatively stable performance as indicated by low CVs. For characters where lower magnitude is desirable, genotypes in Group III would be most preferred. Group IV is most undesirable group, with low means coupled with large variability. The distribution of the genotypes into the four groups are in Figures 4.1.1 to 4.1.12. The emphasis will be on separating stable from the unstable genotypes, without attempting to further reclassify the unstable below or above average.

4.3.1.1 Yield and yield components.

Seven genotypes mostly local varieties were identified as most desirable in term of good performance as well as stability in yield/plant in Group I (Figure 4.1.1.). They include MC 4, Ch393 (V61), Ch388 (V57), Ch389 (V58), Brebes (V44), Kulai and MC11. Average yielders such Purple Chili, Thai Ch 252-C (V28) and Taiwan (V38) were border line cases. Three varieties namely Ch291 (V1), Lombok (V15) and Ch254 (V9) were in Group II which were relatively high yielding but unstable, probably very responsive to environment changes. The relatively stable varieties but average yielding in Group III were Sri Lanka (V31) and Huey Sithon. Group IV generally consists of unstable varieties with relatively poor performance include average yielders such as Thai Ch252-C-P, Ch387(V56) and Chinese Xian, and low yielders such as Hantaka, Japanese V54 and India Sanam.

For mean fruit weight, eight varieties were found in Group I. Namely MC11, Ch291(V32), Ch388(V57), Ch291-P(V1), Lombok V15), Kulai, Ch393(V61) and Ch254(V9) (Figure 4.1.2 ). The two relatively stable genotypes with slightly below average size in Group III were Indian Sanam, Purple Chili and Xian (V25). The less stable with relatively large fruit size in Group II are Ch389(V58), MC 4 and Ch387(V56). Eight genotypes namely Sri Lanka, Huey Sithon, Taiwan dry chilli, Hantaka, Brebes, Ch252-C, Ch252-C-P and Ch385(V54) were among relatively unstable genotypes with small fruit size (Group IV). However, six of these varieties namely sister lines Ch252-C-P and Ch252-C, Sri Lanka, Huey Sithon, Brebes, Ch385(V54) together with Indian Sanam and Purple chilli were desirable for number of fruits/plant. They produced high number of fruits/plant with relatively low CVs (Group I). Other relatively stable genotypes low fruit number (Group III) were Ch234-14 (MC11), Ch291-P, Kulai, Ch387(V56), Ch291(V32), Ch388(57), Xian, Ch254(V9). Only Taiwan dry chilli showed high fruit number but unstable in Group II (Figure 4.1.3). For dry yield five varieties were found in Group I (Figure 4.1.4). They were Sri Lanka, Huey Sithon, Taiwan dry chilli, MC11 and Brebes. The local Kulai was relatively stable but below average yield (in Group III).

4.3.1.2. Agronomic characters

As low magnitude is desirable for days to harvest, the most desirable varieties are those found in Group III (Figure 4.1.5). The relatively stable and early maturing varieties include Ch387 (V56), Xian, Brebes, Ch385 (V54), Purple chilli, Ch389 (V58), Ch291 (V32), Lombok (V15), Ch252-C (V28), India Sanam, Ch252-C-P, MC11, Ch388 (V57). The early maturity but relatively unstable (Group IV) are Hantaka and Huey Sithon, both are of exotic origins. The late varieties but relatively stable are Huey Sithon, Taiwan dry chilli, Ch393(V61), Kulai and MC11 (Group I). The undesirable late unstable varieties are V31 and V1 (Group II).

For plant height, six varieties were found in Group I, Seven in Group II, three in Group III and six in Group IV (Figure 4.1.6). In Group I, variety V49 are the tallest with the lowest CV. Other varieties found in Group I include Purple, Ch388 (V57), Ch387(V56), Huey Sithon and Sanam. Those varieties which were short but stable in Group III include Lombok, Sri Lanka and Ch254 (V9) with height slightly below average. The unstable and tall genotypes found in Group II include Kulai , MC4, Ch393(V61), Ch291-P, Ch252-C, MC11 and Ch389(V58). Six unstable and short genotypes in Group IV were Ch385(V54), Taiwan dry chilli, Hantaka, Korean Ch291(V32), Brebes and Chinese Xian.

Character days to dry is desirable when the magnitude is low. Therefore, the most preferred varieties would be those in Group III with low number of days taken to dry and low CVs. Eight varieties found in this group are Indian Sanam, Purple Chilli, Ch252-C-P, Xian, Ch252-C(V28), Taiwan dry chilli, Huey Sithon and Hantaka. Three varieties showed less time taken to dry with high CV (Group IV) were Ch291(V32), Brebes and Sri Lanka. The two locally developed chilli varieties MC 4 and MC11 are in Group I, with longer drying time but low CV. Others in this group were Ch387(V56), Ch291-P(V1), Ch393(V61). Genotypes Ch385(V54) and Ch388(V57). Under natural drying, the most undesirable varieties in Group II with above average drying period and high CVs were V9, V15, V40 and V58 (Figure 4.1.7).

For dry weight, nine varieties namely Sri Lanka, Huey Sithon, Ch385(V54), Ch252-C(V28), Ch252-C(P), Taiwan dry chilli, Brebes, Xian and Hantaka are found in the most preferred Group 1 (Figure 4.1.8). The big fruit varieties namely Ch291 (V32), Ch388(V57) and Ch389(V58) are relatively stable but showed below average mean dry weight (Group III). Varieties Ch252-C-P, India Sanam and Purple chilli showed high dry weight but unstable performance (Group II). The most undesirable varieties were those in group IV with lower than average solid content and high CV. These varieties include Ch254(V9), Ch291-P (V1), Ch393(V61), Lombok(V15), Kulai, MC4, MC11 and Ch387(V56).

For conversion rate (Figure 4.1.9), the most desirable varieties in Group I include Sri Lanka, Huey Sithon, Ch385(V54), Ch252-C(V28), Ch252-C-P, Taiwan dry chilli, Brebes, Xian and Hantaka. Sanam and purple chilli showed high conversion rate with considerably high variability. The big fruit varieties such as Korean Ch291(V32), Ch388(V57), Ch389(V58) and Ch254 (V9) were stable but of below average means (Group III). With regards to conversion rate, the most unstable varieties with below average conversion rate (Group IV) were varieties Ch291-P (V1), Ch393(V61), Lombok(V15), Kulai, MC4, MC11 and Ch387(V56).

4.3.1.3 Quality characters

For percentage of bleaching, the desirable Group III with low percentage and low CV

(Figure 4.1.10) include Sri Lanka, Brebes, Ch388 (V57) and Xian. Genotypes such as V36, V39, V16, V28, V46, India, V54 and V49 though low bleaching but relatively unstable (Group IV). Varieties such as V1, MC 4, V15, V9, V38, V58, V32, V61 and V15 showed consistently high percentage of bleaching. Genotype V40 exhibited high percentage of bleaching with high CV.

Light transmission reflects the colour intensity of the genotypes in question. The higher the light transmission the lighter is the intensity of the colour. Grouping for light transmission is presented in Figure 4.1.11. Group III is the most favourable group which consists of Indian Sanam . Group IV consisting of those genotypes with high colour intensity and high CV are Ch393(V61), Purple chilli, Huey Sithon, Ch252-C(V49), Ch387(V56), Ch385(V54), Xian, Sri Lanka, Lombok, Hantaka and Brebes. However, Korean lines Ch291 (V32) and Ch291-P, MC11, Ch252-C are in Group I, with less intense colour but relatively stable. Group II which exhibits low colour intensity with high CV consisted of Taiwan dry chilli, Ch254 (V9), MC 4, Ch389(V58), Ch388(V57) and Kulai .

Figure 4.1.12 illustrates the grouping-technique applied to capsaicin.content. The most preferred varieties with regards to capsaicin were Thai Ch252-C-P, Sri Lanka, Ch393(V61), Xian, Purple chilli, Thai Ch252-C(V28), Ch388(V57) (Group I). Varieties Brebes, Ch385 (V54) and Huey Sithon were in Group II, with high capsaicin level but exhibit inconsistent performance. Group III varieties with below average capsaicin content but stable low performance include two Korean lines namely Ch291-P (V1) and Ch291 (V32), and MC11. Below average capsaicin and high CVs (Group IV) were MC 4, Ch254 (V9), Taiwan dry chilli, Hantaka, Ch389 (V58), Ch387 (V56) and Lombok.

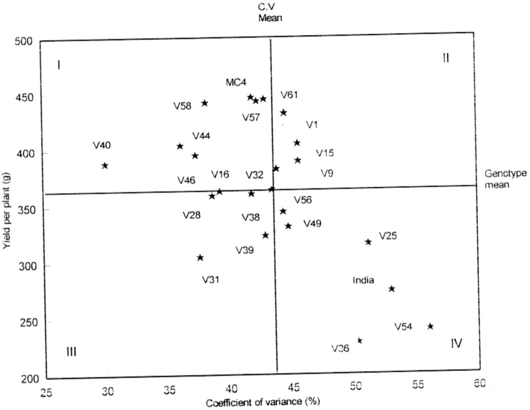



Figure 4.1.1. Distribution of means of yield per plant and coefficients of variance for 22 varieties of chilli

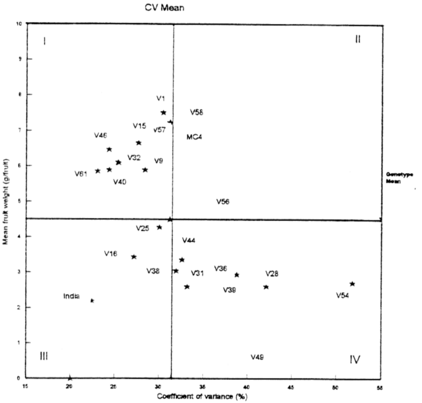



Figure 4.1.2 Distribution of means of mean fruit weight (g/fruit) and coefficients of variance for 22 varieties of chilli

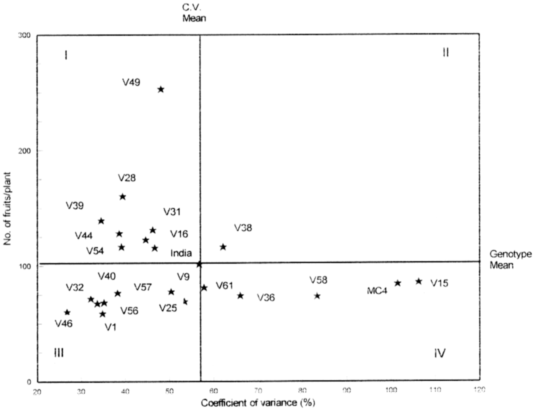



Figure 4.1.3. Distribution of means no. of fruits/plant and coefficients of variance for 22 varieties of chilli

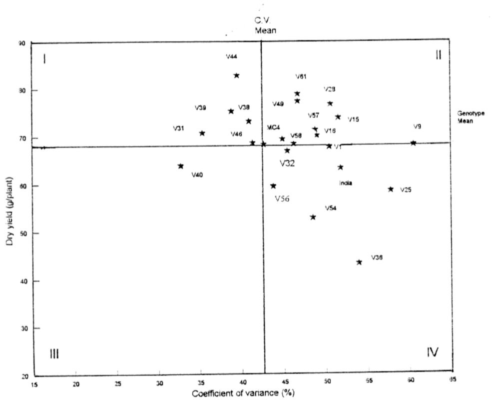



Figure 4.1.4. Distribution of means of dry yield and coefficients of variance for 22 varieties of chilli

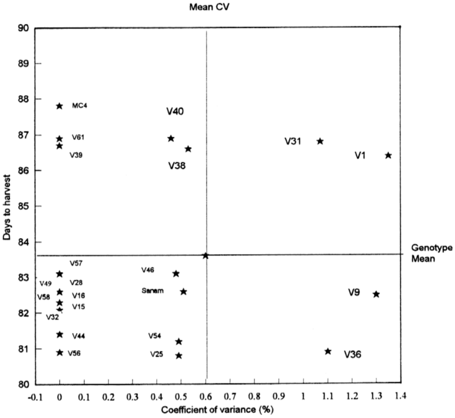



Figure 4.1.5. Distribution of means of days to harvest and coefficients of variance for 22 varieties of chilli

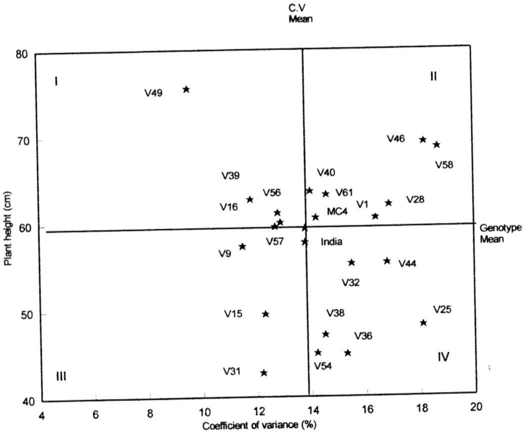



Figure 4.1. 6. Distribution of means of plant height and coefficients of variance for 22 varieties of chilli

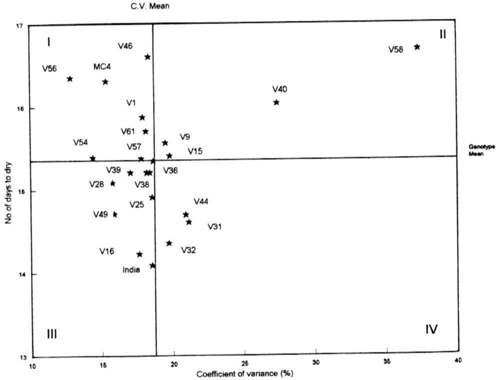



Figure 4.1.7 Distribution of means of days to dry and coefficients of variance for 22 varieties of chilli

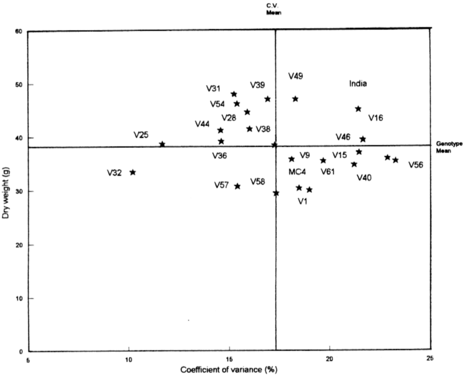



Figure 4.1.8. Distribution of means of dry weight and coefficients of variance for 22 varieties of chilli

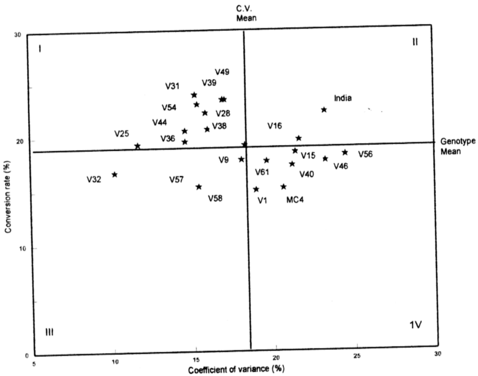



Figure 4.1.9. Distribution of means of conversion rate (%) and coefficients of variance for 22 varieties of chilli

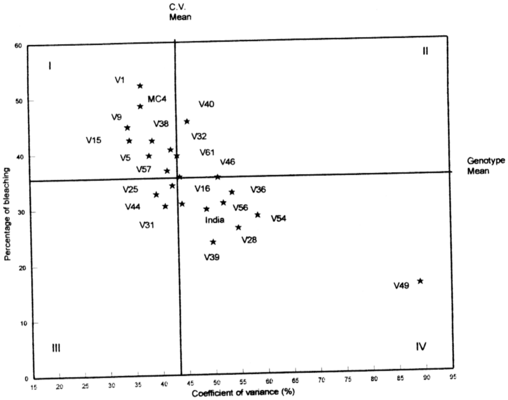



Figure 4.1.10. Distribution of means of percentage of bleaching and coefficients of covariance for 22 varieties of chilli

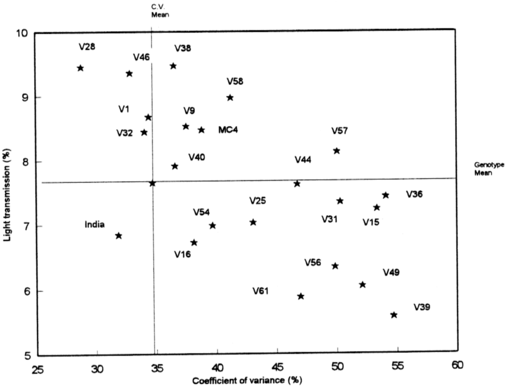



Figure 4.1.11. Distribution of means of light transmission (at 490 nm) and coefficients of variance for 22 varieties of chilli

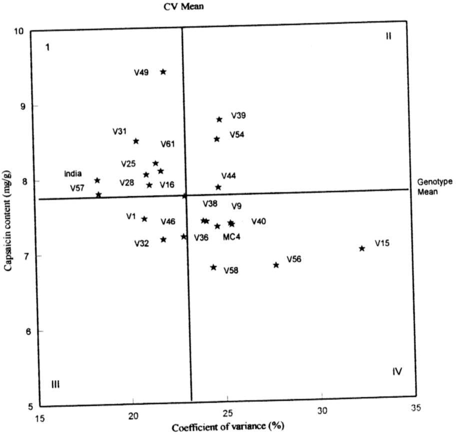



Figure. 4. 1.12. Distribution of means of capsaicin content (mg/g) and coefficients of variance(CV) of 22 varieties of chilli

Key to Figures 4.1.1 - 4.1.12 on pages 186-197

| | |
|---|---|
| V1 | Ch291-P |
| V9 | Ch254 |
| V15 | Ch284-6 |
| V16 | Purple |
| V25 | Xian (Ch257) |
| V28 | Thai Ch252-C |
| V31 | Sri Lanka |
| V32 | Ch291 |
| V36 | Hantaka (Ch286) |
| V39 | Huey Sithon |
| V40 | Kulai |
| V44 | Brebes |
| V46 | MC11 |
| V49 | Ch252-C-P |
| V54 | Local Japan (Ch385) |
| V56 | Ch387 |
| V57 | Ch388 |
| V58 | Ch389 |
| V61 | Ch393 |
| V63 | MC4 |
| V64 | Indian Sanam |

### 4.3.2 Regression and Deviation

The magnitude of individual regression coefficient ( $b_i$ ) can be interpretted as a measure of stability of a genotype, a low value indicating stability ($b_i$<1) and a high value($b_i$>1) indicating instability. Genotype with regression coefficients not significantly different from one are those performing almost similarly with the average performance of all genotypes in the environments tested. According to Eberhart and Russell (1966) working on several sets of data on maize regarded the best group ( $b_i$ =1) as genotypes with average adaptability/stability. Genotypes with regression coefficients significantly higher than one ( $bi$ >1) usually has mean above the grand mean or below average stability are those which adapt very well to good environments but performed poorly in unfavourable environments. They are very responsive to changes in environments. Thirdly, the group with those genotypes showing regression coefficients significantly below one ($bi$<1) and means below the grand mean; they are above average stability, less sensitive to environment changes, with relatively small fluctuation in performance in poor as well as in good environments.

Another statistics, i.e., deviation from regression, was in corporated as a second stability parameter. A small deviation from regression was considered more stable. Hence, the most desirable variety would be the one that performs above average in all environments, a variety with high mean, unit regression coefficient ($b_i$ = 1.0) and the deviation from regression as small as possible (($S^2_d$) $_i \rightarrow 0$). Therefore, the ideal variety would be the one with $bi$=1.0 and ($S^2_d$) $_i$ = 0.

4.3.2.1 Yield and yield components

For yield (Table 4.24.1), three varieties tested had regression coefficient $b_i > 1$, and five varieties recorded $b_i = 1$, while the other 12 showed $b_i < 1$, indicating most of the varieties tested were not very responsive to environment. These less responsive varieties include Taiwan dry chilli, Lombok, Thai Ch252-C, Japanese Hantaka and Local Japanese Ch386 (V54) exhibiting $b_i = 0.13$, $b_i = 0.52$, $b_i$=0.53, $b_i = 0.57$, and $b_i = 0.62$ respectively. With the exception of Lombok, all small fruit varieties appeared relatively stable. The varieties with average performance ($b_i = 1$) showing wide adaptability include varieties Chinese Xian, Kulai, Brebes, Ch388 and Ch389. As in previous method, the high yielding variety MC4 was most responsive to environmental change.

For fruit number, two varieties showed average stability with $b_i = 1$. These varieties were Ch 284-6 (0.964) and Brebes (1.037). Twelve varieties with $b_i < 1$ were Ch 388(V57), Ch393(V61), Taiwan dry chilli , Ch 254, MC11, Xian and Hantaka. While the most responsive varieties with $b_i$>1 were Purple Chilli ($b_i$=2.19), Ch385(V54), Sri Lanka, Huey Sithon, India Sanam, Ch 252-C-P (Table 4.24.1).

The most stable varieties for mean fruit weight where $b_i < 1$, were Ch252-C-P ($b_i$= 0.15) and Sri Lanka ($b_i$=0.29) (Table 4.24.1). While Ch387 ($b_i$=1.00), Kulai ($b_i$=1.03), Xian (Ch257) ($b_i = 0.91$, $(S^2_d)_i$ =0.016) were of average stability. Six varieties showed below average stability in fruit size. These varieties with $b_i$ significantly bigger than one were Lombok (Ch 284-6), Ch389, MC11 and MC 4. The bigger the fruit size the less stable were the varieties.

For dry yield, eight varieties with $b_i$=1.0 and the smallest $b_i$ was >0.6 (Table 4.24.1). This indicates that most of the varieties showed Type II stability of Lin *et al.* (1986) and eight of the varieties were wide adaptable varieties.

4.3.2.2 Agronnomic characters

For days-to-harvest , the most stable variety is V1 while the most responsive with $b_i$>1 were Sri Lanka, Kulai, Brebes, MC11, Ch393 and MC4 (Table 4.24.2). For plant height, there were four genotypes with average adaptability ($b_i$=1) namely Ch389(V58), MC11, Brebes, Ch254(V9), Ch252-C(P), Ch385(V54), Purple Chilli and Ch254. Six genotypes exhibiting *bi* >1, These tall varieties which responsive to change in environment were Ch 286 (V31), Ch 381(V36), India, MC 4, Ch 388 (V57) and Ch393 (V61). Of these genotypes Ch388 had the least $(S^2_d)_i$ of 1.495 followed by Ch 393 with $(S^2_d)_i$ = 7.011. Seven genotypes showing $b_i$ tending towards zero ( $b_i$<1) were Ch291(V32), Huey Sithon, Kulai, Ch387(V56), Ch 385 (V54), Ch 291 (V1) and Taiwan dry chilli (Table 4.24.2).

For number of days taken to dry, the genotype with the least *bi* (0.4750) was Ch 389 (V58) (Table 4.24.2), followed by six other genotypes namely Ch 388($b_i$ =0.72, $(S^2_d)_i$=0.21) , Ch 284-6 with *bi*=0.616 and $(S^2_d)_i$ =0.33, Taiwan dry chilli, MC11( 0.777), Ch291-P (0.787) and Ch385 with $b_i$ = 0.952 and $(S^2_d)_i$ =1.967. Genotypes with $b_i \pm 1$ were Ch 393 wth $b_i$=1.003 and $(S^2_d)_i$ = 0.032 , MC 4 with $b_i$= 1.011 and $(S^2_d)_i$ =1.119, Sri Lanka $b_i$=0.99 and $(S^2_d)_i$ = -1.552, Purple Chilli with $b_i$ =1.032 and $(S^2_d)_i$= -4.462. Two genotypes with $b_i$ >1 were Kulai with $b_i$ =1.064 and $(S^2_d)_i$ = -1.747 and India with $b_i$=1.076 and $(S^2_d)_i$ = 3.020. These genotypes were average stability over all locations.

For dry weight, three genotypes exhibited $b_i = 1$. namely Taiwan dry chilli (CK #IT) with $b_i$ =1.003 and $(S^2_d)_i$ = 5.362, Brebe with $b_i$ = 0.994 and $(S^2_d)_i$ =18.62, Ch393 with $b_i$ = 0.91 and $(S^2_d)_i$ = -5.145. Twelve genotypes which showed above average stability ( with $b_i$<1) were Ch 254, Ch 389, MC 4, V56, Ch 291P , Kulai, Ch 291 Hantaka, Ch 389. Seven genotypes with below average stability ($b_i$>1) were Xian (Ch 257), Ch385, India Sanam, Purple Chilli, Ch 252-C, Huey Sithon and Sri Lanka (Table 4.24.2).

For conversion rates, genotypes with the $b_i$ = 1 include MC11 (Ch234-14) and others with $b_i$ tending towards 1 in descending order were Taiwan dry chilli (CK#IT), Hantaka (with least $(S^2_d)_i$ =0.207), Ch291, Ch284-6, Ch389, Ch29-P, Ch393, Ch254, Sanam and the least $b_i$= 0.254 was showed by MC 4. The most responsive genotypes with $b_i$ > 1 in ascending order were Ch387(V56), Brebes, Ch388, Xian, Ch385, Huey Sithon, Ch252-C(P), Sri lanka, Purple Chilli and Ch252-C (Table 4.24.2).

4.3.2.3.Quality characters

Regarding percentage of bleaching, several genotypes appeared to show average stability. These were Ch 284-6 ($b_i$=0.996) , Sri Lanka with $b_i$=1.017, Ch 234-14, MC 4 ($b_i$=1.041), brebes ($b_i$=1.069), and Huey Sithon ($b_i$=1.079) and Purple chilli with $b_i$=0.984. Those with above averaga stability were Ch252-C-P, Ch385, Ch291, Ch257, Ch291-P, Those genotypes which were below average stability were Hantaka, Ch387(V56), Ch388, Ch389, Ch254 and Taiwan dry chilli (CK #IT) (Table 4.24.3)

As for light transmission, genotypes India Sanam, Purple chilli showed average stability over all locations. This was followed by genotypes Ch 257 and V56 which showed $b_i$=0.942 and $b_i$=0.947, respectively (Table 4.24.3). Most of the varieties were above average stability. The variety with the least $(S^2_d)_i$ of 0.556 was Ch384-6 ($b_i$=0.907).

Genotype Ch385 showed the least $b_i$ of 0.341 in capsaicin level. This was followed by Ch 252-C-P, CK # IT, Ch257, Ch284-6, Ch 291 with $b_i$ =0.783 and $(S^2_d)_i$ =0.840, Sri lanka, India Sanam, Kulai, Hantaka, Ch387(V56) and Ch252-C. Those genotypes showing average stability over all environments ( $b_i \pm 1$) were Huey Sithon. ($b_i$=0.982), Purple chilli ($b_i$=1.033), Ch291(P) and Ch389 ($b_i$=1.066). While genotypes which showed $b_i$ >1 were Ch 393, Ch234-14, Brebes, Ch388, Ch 254 and MC 4 (Table 4.24.3).

Table 4.24.1 Estimates of regression coefficients and stability variance for yield and yield components in chilli

| Varietal code/Varieties | Yield (g/plant) | | No of fruits /plant | | Mean fruit weight (g) | | Dry yield (g/plant) | |
|---|---|---|---|---|---|---|---|---|
| | $b_i$ | $(S^2_d)_i$ x1000 | $b_i$ | $(S^2_d)_i$ | $b_i$ | $(S^2_d)_i$ | $b_i$ | $(S^2_d)_i$ |
| V1. 291- P | 1.19*** | 1.564 | 0.564*** | -2211.17 | 1.26 | 0.894** | 1.041*** | -60.85 |
| V9. Ch 254 | 1.23*** | 0.392 | 0.738*** | -1921.05 | 1.44 | 0.788** | 1.030*** | 26.90 |
| V15. Ch 284-6(Lombok) | 0.52* | 34.559** | 0.964** | 1369.14 | 1.77 | 2.737** | 1.275*** | 17.60 |
| V16. Purple Chilli | 0.85*** | 25.647** | 1.079*** | -1437.54 | 0.73 | -0.073 | 0.913*** | 144.95 |
| V25. Ch 257(Xian) | 0.95** | 55.677** | 0.722*** | -1307.00 | 0.91 | -0.223 | 0.963*** | 875.35** |
| V28. Ch 252-C | 0.57* | 57.031** | 2.192*** | 221.17* | 0.61 | 0.298 | 1.170*** | 740.89** |
| V31. CH 286 Sri Lanka | 0.73** | 32.998** | 1.445*** | -1834.47 | 0.29 | 1.368** | 1.071*** | 226.24* |
| V32. Ch 291 | 0.65** | 31.935** | 0.668*** | -1164.91 | 1.38 | 2.528** | 0.888*** | 373.82** |
| V36. Ch 381 Hantaka | 0.53* | 44.004* | 0.689** | -981.98 | 0.60 | -0.173 | 0.637*** | 133.47 |
| V38. Taiwan dry chilli (Ck#IT) | 0.13 | 62.470** | 0.881** | -85.48 | 0.66 | -0.193 | 1.204*** | 28.35 |
| V39 Huey Sithon | 0.85*** | -1.978 | 1.450*** | -1064.25 | 0.73 | 0.028 | 1.008*** | -58.1 |
| V40. Kulai | 0.96*** | 3.229 | 0.513*** | 292.67 | 1.03 | -0.113 | 0.797*** | -125.35 |
| V44. Cabe Berebes | 1.08*** | 7.329* | 1.037** | 1732.14 | 0.69 | 1.198** | 0.904*** | 65.20 |
| V46. Ch 234-14(MC11) | 1.14*** | 1.509 | 0.459*** | 2035.80 | 1.69 | 0.848** | 1.054*** | 287.26** |
| V49. Ch 252-C(P) | 0.71*** | 14.359** | 1.505** | 5228.99 | 0.15 | -0.283 | 0.947*** | 1268.95** |
| V54. Ch 385 (MC) | 0.62*** | 2.071 | 1.289*** | 1623.31 | 0.46 | 0.328* | 0.812*** | 54.49 |
| V56. Ch387(MC 01110-1) | 0.77*** | 9.460** | 0.665*** | -1639.47 | 1.01 | 0.238 | 0.766*** | 120.94 |
| V57. Ch 388 (MC) | 1.77*** | 4.644* | 0.862*** | -1145.85 | 1.25 | 2.998** | 1.009*** | 160.32 |
| V58. Ch 389 (MC) | 1.08*** | 7.900* | 0.532* | -148.15 | 2.00 | 2.758** | 0.958*** | 137.45 |
| V61. Ch 393 (MC) | 0.78** | 50.993** | 0.859*** | -946.93 | 1.29 | 3.548** | 1.050*** | 198.25* |
| V63. MC 4 | 1.43*** | 10.080** | 0.417 | 7399.15*** | 1.61 | 0.998** | 1.122*** | 439.65** |
| V64. Indian Sanam | 0.069*** | 11.923** | 1.602 *** | 57.49 | 0.41 | -0.303 | 1.080*** | 561.23** |

*, **, *** @ Significant for $p \leq 0.05, 0.01, 0.001$ respectively

Table 4.24.2. Estimates of regression coefficients and stability variance for some agronomic characters in chilli

| Varietal code/ varieties | Days to harvest | | Plant height | | Days to dry | | Dry weight (g) | | Conversion rate (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $b_i$ | $(S^2_d)_i$ | $b_i$ | $(S^2_d)_i$ | $b_i$ | $(S^2_d)_i$ | $b_i$ | $(S^2_d)_i$ | $b_i$ | $(S^2_d)_i$ |
| V1. 291- P | -0.137 | 3.555* | 0.628 | 32.43** | 0.787 | 3.555* | 0.63 | 51.91 | 0.69 | 8.355** |
| V9. Ch 254 | -0.808 | 1.045 | 0.971 | 23.97* | 0.941 | 1.045 | 0.24 | -1.31 | 0.66 | 2.756* |
| V15. Ch 284-6(Lombok) | -0.812 | 4.735** | 0.942 | -1.25 | 0.616 | 4.735** | 0.80 | -4.88 | 0.79 | 5.23** |
| V16. Purple Chilli | -0.812 | -0.065 | 0.948 | 67.77** | 1.032 | -0.065 | 1.35 | -0.77 | 1.72 | 6.258** |
| V25. Ch 257(Xian) | -0.882 | 2.395* | 1.125 | 64.2** | 0.820 | 2.395* | 1.21 | -23.55 | 1.32 | 3.469** |
| V28. Ch 252-C | -0.795 | 5.135** | 0.847 | 106.31** | 0.896 | 5.135** | 1.51 | 8.10 | 1.74 | 12.59** |
| V31. CH 286 Sri Lanka | -1.354 | 2.845* | 1.195 | 65.13** | 0.99 | 2.845* | 1.72 | 16.99 | 1.62 | 14.18** |
| V32. Ch 291 | -0.836 | 2.095* | 0.445 | 71.85** | 0.825 | 2.095* | 0.72 | -11.15 | 0.77 | 4.086** |
| V36. Ch 381 Hantaka | -0.882 | 3.405** | 1.451 | 28.45* | 0.931 | 3.405** | 0.83 | -2.45 | 0.86 | 7.762** |
| V38. Taiwan dy chilli (CK#IT) | -1.369 | 0.745 | 0.822 | 57.67** | 0.764 | 0.745 | 1.00 | 5.36 | 0.90 | 10.089** |
| V39 Huey Sithon | -1.370 | -0.555 | 0.466 | 116.8** | 0.936 | -0.555 | 1.66 | -0.32 | 1.44 | 12.768** |
| V40. Kulai | -1.345 | 2.645** | 0.526 | 36.54** | 1.064 | 2.645** | 0.64 | 0.21 | 0.83 | 5.937** |
| V44. Cabe Berebes | -0.787 | 7.365** | 1.048 | -1.0 | 0.859 | 7.365** | 0.99 | 18.62 | 1.22 | 9.024** |
| V46. Ch 234-14(MC11) | -0.795 | 4.635** | 0.975 | 15.69** | 0.777 | 4.635** | 0.83 | -0.68 | 0.96 | 6.741** |
| V49. Ch 252-C(P) | -0.795 | 6.745** | 0.968 | 56.6** | 0.923 | 6.745** | 0.82 | 22.31 | 1.59 | 1.991 |
| V54. Ch 385 (MC) | -0.875 | 6.758** | 0.760 | 55.35** | 0.952 | 6.758** | 1.24 | 8.24 | 1.41 | 22.269** |
| V56. Ch387(MC 01110-1) | -0.888 | 9.335** | 0.695 | 55.64** | 0.816 | 9.335** | 0.78 | 0.16 | 1.22 | 11.726** |
| V57. Ch 388 (MC) | -0.778 | 4.615** | 1.404 | 357.15** | 0.720 | 4.615** | 0.87 | 13.37 | 1.23 | 1.149 |
| V58. Ch 389 (MC) | -0.812 | 12.345** | 0.992 | 51.37** | 0.475 | 12.345** | 0.38 | -2.37 | 0.74 | -0.441 |
| V61. Ch 393 (MC) | -1.345 | 4.345** | 1.590 | 39.58** | 1.003 | 4.345** | 0.91 | -5.15 | 0.66 | 8.363** |
| V63. MC 4 | -1.320 | 5.545** | 1.313 | 56.89** | 1.011 | 5.545** | 0.62 | 10.67 | 0.25 | 4.514* |
| V64. IndiaSanam | -0.795 | 7.415** | 1.24 | 102.09** | 1.076 | 7.415** | 1.37 | -12.01 | 0.28 | 22.778** |

*, **, *** @ Significant for $p \leq 0.05, 0.01, 0.001$ respectively

Table 4.24.3 Estimates of regression coefficients and stability variance for some quality characters in chilli

| Varietal code/Varieties | % of bleaching | | light transmission at 490 nm (%) | | Capsaicin (mg/g) | |
|---|---|---|---|---|---|---|
| | $b_i$ | $(S^2_d)_i$ | bi | $(S^2_d)_i$ | $b_i$ | $(S^2_d)_i$ |
| V1. 291- P | 0.87 | 60.47* | 1.45*** | 5.39** | 1.05 | 18.74** |
| V9. Ch 254 | 1.25 | 119.40** | 1.46*** | 2.84** | 1.13 | 19.99** |
| V15. Ch 284-6(Lombok) | 0.99 | 53.61* | 0.91** | 9.38** | 0.67 | 25.4** |
| V16. Purple Chilli | 0.98 | 53.80* | 0.99*** | 0.16 | 1.03 | 15.96** |
| V25. Ch 257(Xian) | 0.87 | 23.57 | 0.94*** | 3.47** | 0.66 | 14.52** |
| V28. Ch 252-C | 0.91 | 174.95** | 0.88* | 15.23** | 0.90 | 11.71** |
| V31. CH 286 Sri Lanka | 1.02 | 57.82 | 0.70** | 7.73** | 0.78 | 17.27** |
| V32. Ch 291 | 0.86 | 144.55 | 1.42*** | 3.13** | 0.78 | 9.28** |
| V36. Ch 381 Hantaka | 1.12 | 37.23 | 1.12*** | 4.52** | 0.84 | 27.96** |
| V38. Taiwan dry chilli(CK#IT) | 1.35 | 7.13 | 1.20*** | 3.05** | 0.63 | 25.42** |
| V39 Huey Si Thon | 1.08 | 148.82** | 0.81*** | 1.43** | 0.98 | 28.00** |
| V40. Kulai | 0.69 | 0.58 | 0.78* | 10.42** | 0.81 | 12.01** |
| V44. Cabe Berebes | 1.07 | 59.25** | 0.92* | 16.92** | 1.11 | 11.58** |
| V46. Ch 234-14(MC11) | 1.04 | 9.57 | 0.61 | 18.42** | 1.10 | 35.46** |
| V49. Ch 252-C(P) | 0.54 | 18.58 | 0.81* | 18.70** | 0.63 | 14.13** |
| V54. Ch 385 (MC) | 0.59 | 78.22** | 0.71* | 14.33** | 0.34 | 21.65** |
| V56. Ch387(MC 01110-1) | 1.10 | -15.01 | 0.95** | 7.83** | 0.89 | 20.84** |
| V57. Ch 388 (MC) | 1.18 | 58.07* | 0.51 | 9.65** | 1.13 | 40.89** |
| V58. Ch 389 (MC) | 1.30 | 21.08 | 0.61* | 11.72** | 1.07 | 44.15** |
| V61. Ch 393 (MC) | 0.94 | 109.92** | 0.48* | 2.82** | 1.10 | 24.47** |
| V63. MC 4 (Ch234-14) | 1.04 | 75.67** | 0.73** | 6.42** | 1.23 | 11.97** |
| V64. India Sanam | 0.92 | 76.75** | 1.06** | 217.43** | 0.80 | 8.04** |

*, **, *** @ Significant for $p \leq 0.05, 0.01, 0.001$ respectively

*4.3.3 Cross-over and non cross over effects*

Where significant genotype x environment interaction effects are detected, these might manifest as non-cross over or cross over. When there is consistent performance in terms of rank order over a range of environments, there exists a non-cross over effect (Baker 1988) which may be expected in genotype with general or wide adaptability. Alternatively, there might be differences in response of a character from one environment to another, thus changing the rank order of a list of genotypes with a change of test environment. Such effect has been name as cross-over effects (Baker 1988), and is of a particular importance in helping the selection of genotypes with specific adaptability to certain environments.

Graphical presentations (Figures 4.2.1- 4.2.12*)* of regression lines of individual genotypes in relation to the environment means for a particular trait demonstrate the presence or absence of cross-over effects.

4.3.3.1. Yield and yield components

Graphs of mean yield of 22 varieties against environmental index were presented in Figure 4.2.1. The occurrence of cross over among some of the tested varieties was evident. Most of the tested varieties showed high means in favourable environments and poorly in adverse environments. The most responsive variety, with highest yield in most favourable environment and about average yield in adverse environment was MC4 while variety Ch286 (V15), on the other hand, showed the best yield in poor environment with very little increase in favourable environments. Hence they were suitable for specific adaptability with variety MC4 (V63) for favourable environment and Lombok (V15) for less favourable environment. Variety Ch 291(V32) showed reasonably good performance in adverse environment and showed some response with change in environments.

For mean fruit weight, some varieties within the limit of the tested environment showed some crossover effect (Figure 4.2.2). The most responsive varieties were generally had big fruits like MC4, Ch389 (V58), MC11 and Lombok (V15). While varieties such as Ch387 (V56), Kulai, Ch291-P (V1), Ch291 (V32), Xian showed only slight increase in fruit size in favourable environments. Small fruit varieties such Ch252-C-P and Sri Lanka appeared to be most stable.

There was evidence of some cross-over among varieties in number of fruits/plant due to Huey Sithon and Ch286 being more responsive to environment than others (Fig. 4.2.3).

With regards to dry yield, a very distinct evident of cross-over among varieties was observed. Selection for dry yield based on the population studied might not be very effective (Fig. 4.2.4).

4.3.3.2. Agronomic characters

Days to harvest showed good response with change in environment with one group being more responsive than the other resulting in cross-over. The means tend to converge at lower range (Fig. 4.2.5).

For plant height (Fig.4.2.6), most varieties showed similar response to favourable environment except for Lombok (V15) and Ch291 (V32) which showed only small response to favourable environment.

For days to dry, all varieties appeared parallel to each other except for V58 which showed less response than other varieties resulting in cross-over (Fig.

4.2.7). For dry weight, cross-over among varieties was due to Ch254 cutting Ch286, Huey Sithon (V39) at the lower range and due to Ch388 (V57), V58, V1 and V49 cutting Ch286, V39 and V28 at higher range (Fig. 4.2.8). Figure 4.2.9. showed cross-over among varieties for conversion rate. Two varieties showed very low change and parallel to each other. Most of the varieties appeared to diverge at higher range

4.3.3.3. Quality characters

With regards to quality characters, genotypic means against environmental index for each of quality characters were presented in Figs 4.2.10-4.2.12. There was evidence of cross-over in all characters.

For % of bleaching (Fig.4.2.10) evidence of cross-over was observed among varieties. Variety Ch252-C-P however, showed low response to changes and was not involved in the cross-over. For light transmission (colour), cross- over effect was seen between varieties Ch291 (V1) and MC4, Taiwan dry chilli and Ch388, Ch393 and Huey Sithon at lower range and MC4 and Ch393 at higher range. The most stable variety here was Huey Sithon (Fig. 4.2.11).

With regards to capsaicin, all varieties were responsive to environments. Evident of cross over was observed among varieties (Fig. 4.2.12) due to unequal response of the varieties to changes in the environments. More pungent varieties appeared to be less responsive e.g. Ch252-C-P, Ch385 (V54) compared to the less pungent varieties namely MC4 and Ch389.

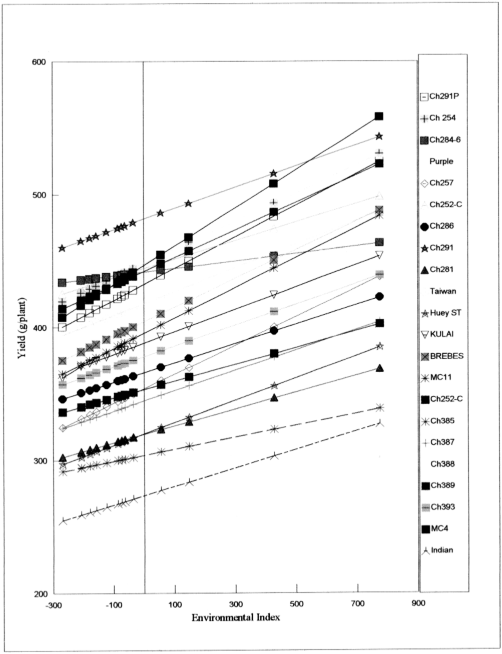



Figure 4.2.1. Plot of regression lines of individual genotypes against environmental index for yield per plant

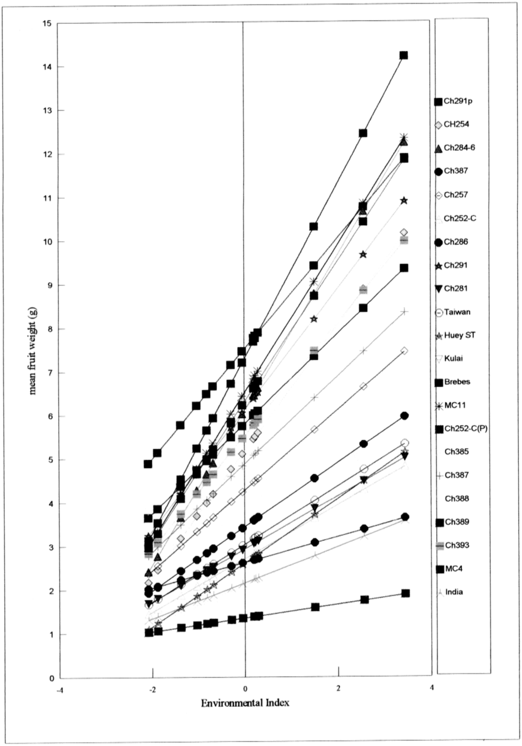



Figure 4. 2.2. Plot of regression lines of the individual genotypes against environmental index for mean fruit weight

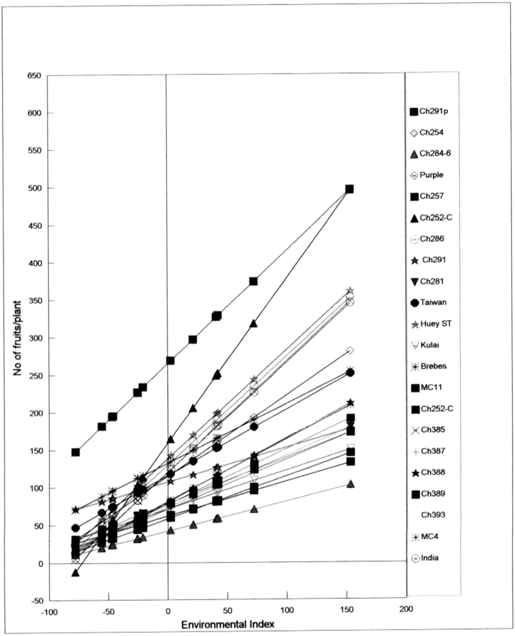



Figure 4. 2.3. Plot of regression lines of individual genotypes against environmental index for no. of fruits/plant

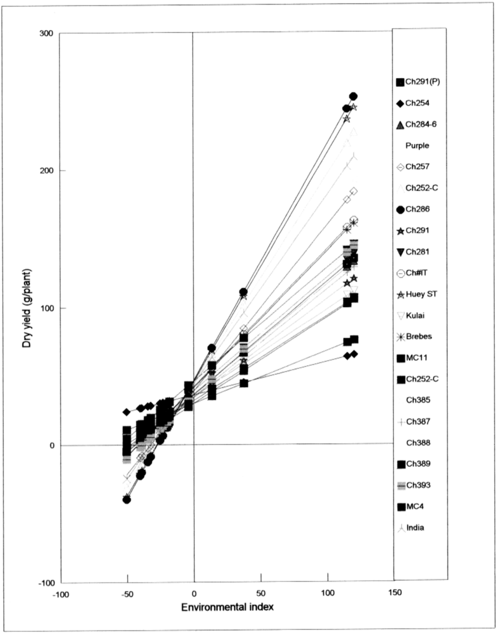



Figure 4.2.4. Plot of regresssion lines of individual genotypes against environmental index for dry yield

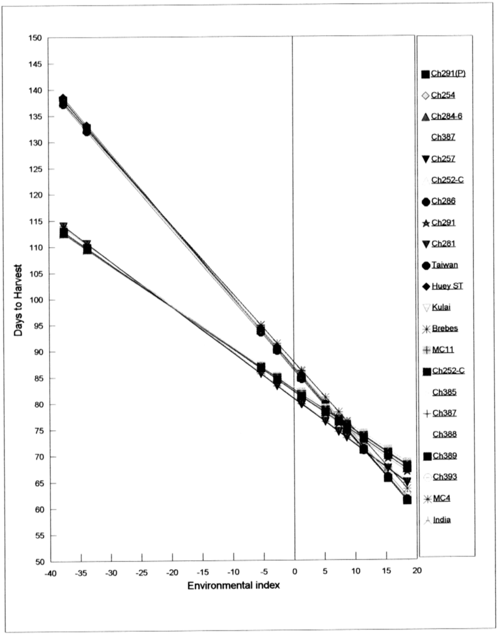



Figure 4. 2.5 Plot of regresssion lines of individual genotypes against environmental index for days to harvest

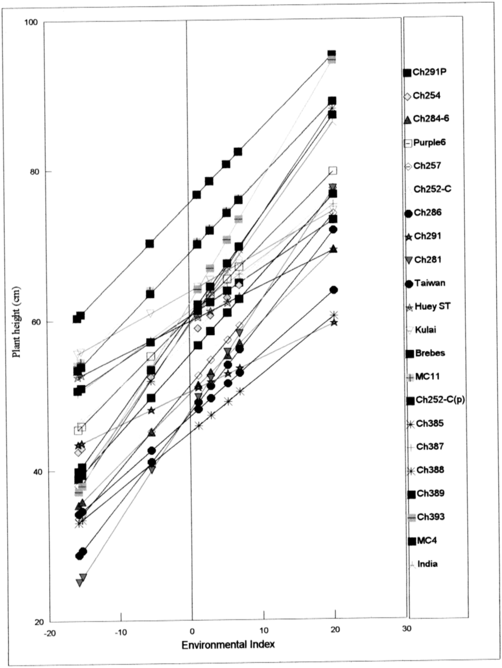



Figure 4.2.6. Plot of regression lines of individual genotypes against environmental index for plant height

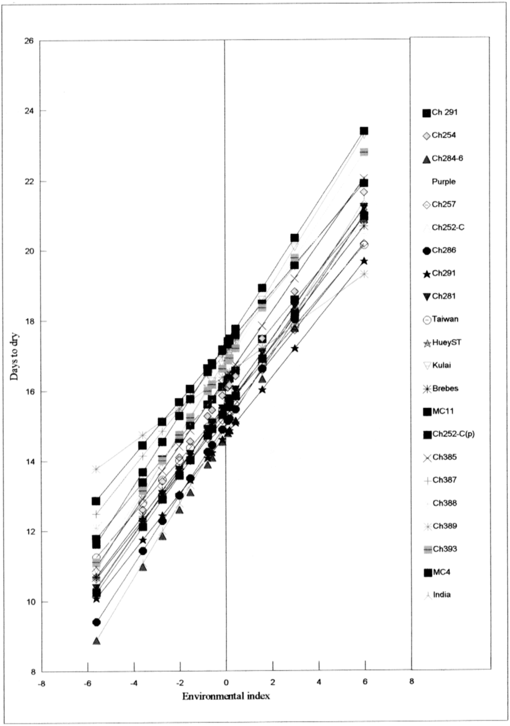



Figure 4. 2.7. Plot of regression lines of individual genotypes against environmental index for days to dry

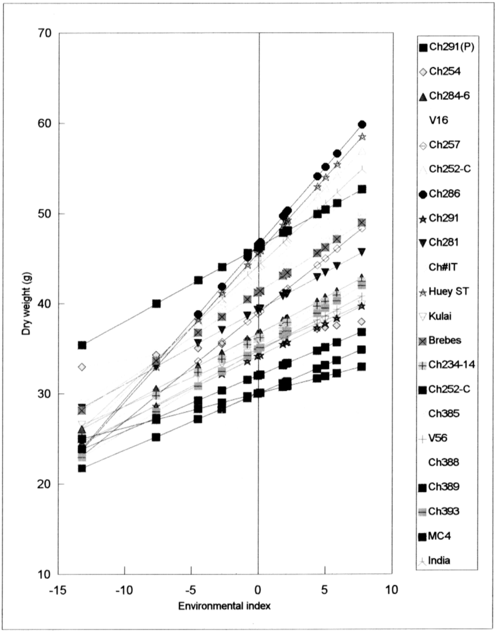



Figure 4.2.8. Plot of regression lines of individual genotypes against to environmental index for dry weight (g)

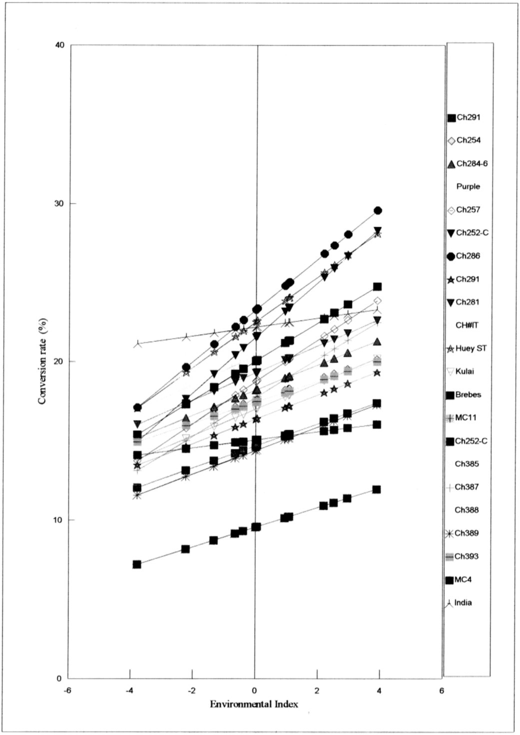
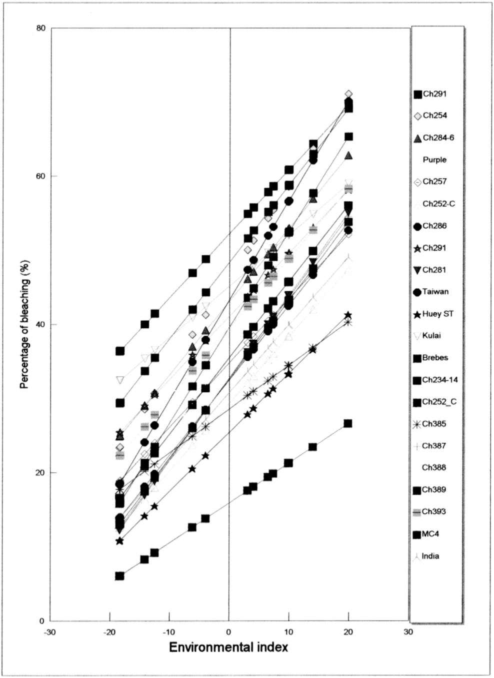



Figure 4. 2.9. Plot of regression lines of individual genotypes against environmental index for conversion rates




'Figure 4.2.10 Plot of regression lines of individual genotypes against environmental index for percentage of bleaching

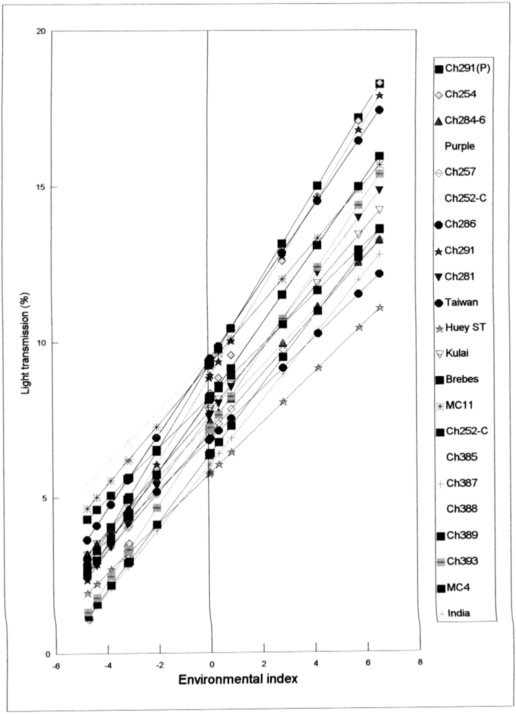



Figure 4.2.11 . Plot of regression lines of individual genotypes against environmental index for light transmission at 490 nm

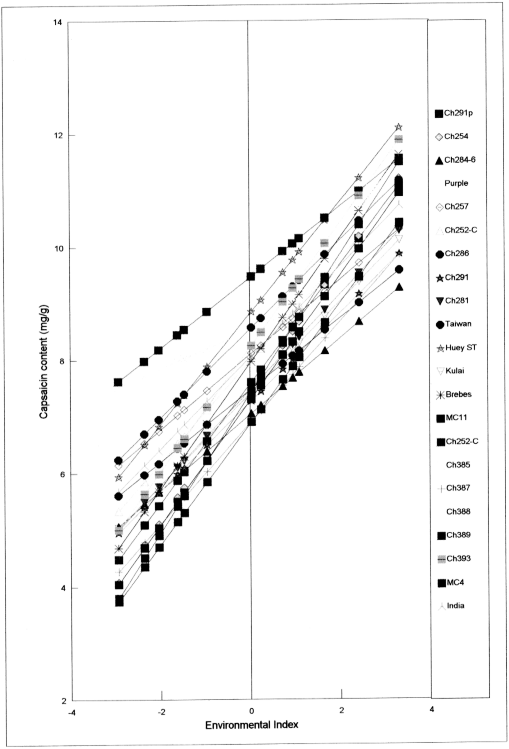



Figure 4.2.12 Plot of regression lines of individual genotypes against environmental index for capsaicin content

### *4.3.4. Ranking methods*

This modified rank-sum method (Kang *et al.* 1991a) assigned equal weights to means and stability-variance statistics. In modified method, stability rating of 0 was assigned for non-significant $\sigma_i^2$, 4 for $\sigma_i^2$ significant at 5% probability level, and 8 for $\sigma_i^2$ significant at 1% probability level. The ratings were added to the mean ranks of a genotype (Tables.4.25.1- 4.27). The genotype with the lowest sum was regarded as the most desirable. In this system, genotypes that were judged to be unstable were penalised in accordance with the significance level of $\sigma_i^2$ and genotypes judged to be stable maintained their original, numerical yield-rank values.

#### 4.3.4.1 Yield and yield components

When stability variances were taken into account, the ranking based on mean changed. MC4, the top yielder dropped in rank due to significant stability variance. Variety Ch291 (V1), rose in rank showing the least rank-sum value. This was followed closely by varieties Ch388, Ch389, Purple and MC4. Others were Ch393, Kulai Brebes, Ch254 and Ch393. Purple chilli was included to replace Ch 284-6, which dropped in ranking, when stability was considered (Table 4.25.1). All except for Ch291-P, Ch254 and Lombok appeared in Group I of Francis and Kennenberg (1978). Varieties Ch291-P, Ch254 and Lombok appeared in Group II. Most of the selected chilli varieties were fresh chilli with few double purpose varieties namely Brebes, Purple, MC11 and Ch291-P.

Although all varieties showed significant stability variance, only slight change from mean ranking was observed for mean fruit weight. Again, Ch291-P showed the least rank-sum. Others were Ch289, Ch388, Ch393, MC11, MC4, Kulai, Ch291, Ch 284-6, Ch 254 and Ch 387. This was followed by MC4, Xian, Purple Chilli and Brebes.

In the case of number of fruits per plant, the mean ranking changes when stability variances were included (Table 4.25.1). For instance, variety Huey Sithon became most desirable followed by Sri Lanka, Ch 252-C, Ch 385, Taiwan dry, Indian Sanam, Purple, Lombok, Ch393, Ch252-C-P and Ch254. Some of the varieties here were also identified desirable by Francis and Kennenberg (1978). This method includes those varieties not observed in Group I of Francis and Kennenberg's.

For dry yield, most varieties showed non-significant stability variance and consequently retained the same ranking. Ch252-C dropped in rank while Huey Sithon showed improvement in rank (Table 4.25.2). Brebes, Ch393, Ch252-C-P showed least rank-sum values.

4.3.4.2 Agronomic characters

For days to harvest, no changes in stability ranking. Based on rank-sum, the most desirable varieties for earliness were Xian, Ch387, Hantaka, Brebes, Ch385(V54), Ch291, Lombok, Purple chilli, Ch389(V58), Ch254 and Indian Sanam (Table 4.26.1).

For plant height (Table 4.26.1), no obvious changes in ranking occurred except for Ch393 and MC4 which dropped slightly. Based on rank-sum, genotypes selected were Ch252-C-P with mean height about 75.6 cm, MC11 (Ch234-14), Ch389, Kulai, Ch 393, Purple chilli, Ch 252-C, V56, MC 4 and Ch 291 (p). Huey Sithon was dropped while Ch388 (59.6 cm) and India Sanam (59.4 cm) were included.

Regarding days to dry there was no change in the rank of the mean after the stability rating was included. The genotypes in ascending order were Indian Sanam (14.1 days), Purple Chilli, Ch291, Sri Lanka, Brebes, Ch252-C-P, Xian (Ch257), Ch 252-C, Hantaka, Taiwan dry chilli and Huey Sithon (Table 4.25.2). Similarly, because of the non-significant stability variances the inclusion of the stability rating made no change in mean ranking in dry weight (Table 4.26.2). The top 50% genotypes in ascending order were Sri Lanka, Huey Sithon, Ch252-C-P, Ch385, India Sanam, Ch 252-C, Taiwan dry chilli, Brebes, Purple chilli, Hantaka and Xian.

For conversion rate, several varieties showed significant stability variance. From the results observed there appeared to be some changes in varietal ranking. When both mean and stability were considered, all varieties dropped in ranking except varieties Brebes, Purple Chilli, Ch252-C, Hantaka, Huey Sithon, Taiwan dry chilli, Xian, Lombok and Ch254. They appeared to improve their positions.

4.3.4.3. Quality characters

Table 4.27. showed ranking and stability ratings for quality traits, i.e., percentage of bleaching, light transmission and capsaicin content.

With light transmission, when both means and stability were considered, there were changes in ranking due to changes in the rank-sum values of the all varieties except Taiwan dry chilli, which remained the least rank-sum value. Other varieties with low rank-sum values were Ch252-C, MC11, Ch389, Ch291, Ch254, MC4, Ch291, Ch388, Kulai and Brebes in descending order.

Similarly, percentage of bleaching showed changes in ranking. However, some varieties such as Ch252-C-P, Ch385, Purple Chilli and Sri Lanka retained in position. Desirable varieties included Ch252-C-P, Huey Sithon, Ch252-C, Ch385, Sri Lanka, Hantaka, Indian Sanam, Brebes, Ch387 (V56) and Xian, MC11.

For capsaicin content, there was a slight change in ranking when both means and stability variance were considered. Varieties Ch 252-C-P (9.41mg/g), Huey Sithon (8.76 mg/g), Sri Lanka, Ch385, Ch 393, Purple Chilli, Ch257, Indian Sanam, Ch252-C, Brebes retained the same ranking. There was a slight drop with Ch385. Variety Ch291 was included to replace Ch388.

Table 4.25.1 Ranking and stability rating (according to Kang 1991a) for yield and yield components of chilli

| Variety | Yield (g/plant) | | | | | Mean fruit weight (g/fruit) | | | | | No.of fruits/plant | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Rank (y) | $\sigma^2_1$ x 1000 | Stability ranking (z) | Rank Sum (y+z) | Mean | Rank (y) | $\sigma^2_1$ x 1000 | Stability Rating (z) | Rank Sum (y+z) | Mean | Rank (y) | $\sigma^2_1$ x 1000 ranking | Stability rating (z) | Rank sum (y+z) |
| Ch291-P(V1) | 432.26 | 5 | 66.032 | 0 | 5 | 7.51 | 1 | 18.144** | 8 | 9 | 58.96 | 22 | 2.969 | 0 | 22 |
| Ch254(V9) | 389 .64 | 9 | 75.964* | 4 | 13 | 5.17 | 10 | 21.110** | 8 | 18 | 77.70 | 13 | 2.051 | 0 | 13 |
| Ch284-6(V15) | 405.07 | 6 | 162.621** | 8 | 14 | 6.10 | 7 | 20.236** | 8 | 15 | 85.50 | 10 | 14.234** | 8 | 18 |
| Purple(V16) | 363.40 | 12 | 79.113* | 4 | 16 | 3.44 | 13 | 11.43** | 8 | 21 | 115.46 | 9 | 3.076 | 0 | 9 |
| Xian Ch257(V25) | 315.65 | 18 | 221.001** | 8 | 26 | 4.28 | 12 | 9.101** | 8 | 20 | 69.01 | 18 | 4.750 | 0 | 18 |
| Ch252-C(V28) | 359.38 | 14 | 193.794** | 8 | 22 | 2.71 | 17 | 12.121** | 8 | 25 | 160.17 | 2 | 40.949 | 8 | 10 |
| Sri Lanka (V31) | 304.82 | 19 | 95.385** | 8 | 27 | 2.63 | 18 | 17.625** | 8 | 26 | 131.13 | 4 | 4.502 | 0 | 4 |
| Ch291(V32) | 381.66 | 11 | 111.477** | 8 | 19 | 6.12 | 6 | 17.544** | 8 | 14 | 71.49 | 17 | 5.848 | 0 | 17 |
| Hantaka (V36) | 227.88 | 22 | 178.058** | 8 | 30 | 2.94 | 16 | 8.419** | 8 | 24 | 74.14 | 15 | 6.417 | 0 | 15 |
| Taiwan DC (V38) | 360.91 | 13 | 387.777** | 8 | 21 | 3.04 | 15 | 8.643** | 8 | 33 | 116.49 | 7 | 8.608 | 0 | 7 |
| Huey Sithon (V39) | 323.70 | 17 | 21.201 | 0 | 17 | 2.61 | 19 | 7.477** | 8 | 27 | 139.46 | 3 | 7.988 | 0 | 3 |
| Kulai (V40) | 388.32 | 10 | 40.935 | 0 | 10 | 5.86 | 9 | 6.602* | 4 | 13 | 67.55 | 20 | 3.401 | 0 | 20 |
| Brebes (V44) | 404.28 | 7 | 78.773* | 4 | 11 | 3.36 | 14 | 23.021** | 8 | 22 | 127.98 | 5 | 13.309* | 4 | 9 |
| MC11 (V46) | 395.15 | 8 | 62.133 | 0 | 8 | 6.48 | 4 | 13.495** | 8 | 12 | 60.29 | 21 | 4.335 | 0 | 21 |
| Ch252-C-P (V49) | 331.22 | 16 | 97.895** | 8 | 24 | 1.34 | 22 | 14.596** | 8 | 30 | 252.80 | 1 | 31.700** | 8 | 9 |
| Ch385 (V54) | 239.13 | 21 | 53.407 | 0 | 21 | 2.08 | 21 | 12.715** | 8 | 29 | 122.41 | 6 | 12.903* | 4 | 10 |
| Ch387 (V56) | 344.7 | 15 | 57.003 | 0 | 15 | 4.92 | 11 | 8.617** | 8 | 19 | 68.30 | 19 | 9.622 | 0 | 19 |
| Ch388 (V57) | 443.06 | 3 | 69.312* | 4 | 7 | 6.66 | 3 | 12.463** | 8 | 11 | 76.62 | 14 | 16.167** | 8 | 22 |
| Ch389 (V58) | 442.04 | 4 | 78.207* | 4 | 8 | 7.24 | 2 | 26.217** | 8 | 10 | 73.5 | 16 | 11.037* | 4 | 20 |
| Ch393 (V61) | 444.71 | 2 | 228.860** | 8 | 10 | 5.95 | 8 | 18.515** | 8 | 12 | 81.19 | 12 | 4.196** | 8 | 20 |
| MC4 (V63) | 446.34 | 1 | 191.201** | 8 | 9 | 6.25 | 5 | 12.063** | 8 | 13 | 84.55 | 11 | 6.172** | 8 | 19 |
| Indian Sanam (V64) | 273.39 | 20 | 76.488* | 4 | 24 | 2.19 | 20 | 9.780** | 8 | 28 | 116.4 | 8 | 3.371* | 4 | 12 |

*, ** @ Statistically significant @ $P \leq 0.05$(5%), $P \leq 0.01$ (1%) respectively

Table 4.25.2 Ranking and stability rating (according to Kang 1991a) of dry yield of chilli

| Variety | Mean | Rank (y) | $\sigma^2_1$ x 1000 | Stability ranking (z) | Rank-sum (y+z) |
|---|---|---|---|---|---|
| Ch291-P(V1) | 67.8 | 15 | 2.012 | 0 | 15 |
| Ch254(V9) | 68.2 | 14 | 2.202 | 0 | 14 |
| Ch284-6(V15) | 73.9 | 6 | 1.703 | 0 | 6 |
| Purple(V16) | 70.2 | 9 | 1.082 | 0 | 9 |
| Xian Ch257(V25) | 58.6 | 20 | 4.388** | 8 | 28 |
| Ch252-C(V28) | 76.8 | 4 | 5.130** | 8 | 12 |
| Sri Lanka (V31) | 70.8 | 10 | 2.019 | 0 | 10 |
| Ch291(V32) | 67.0 | 16 | 3.048* | 4 | 20 |
| Hantaka (V36) | 43.2 | 22 | 4.074** | 8 | 30 |
| Taiwan DC (V38) | 73.2 | 7 | 1.801 | 0 | 7 |
| Huey Sithon (V39) | 75.3 | 5 | 1.023 | 0 | 5 |
| Kulai (V40) | 63.9 | 17 | 1.750 | 0 | 17 |
| Brebes (V44) | 82.9 | 1 | 1.296 | 0 | 1 |
| MC11 (V46) | 68.7 | 12 | 3.651** | 8 | 20 |
| Ch252-C(P)(V49 | 77.4 | 3 | 6.402** | 8 | 11 |
| Ch385 (V54) | 52.9 | 21 | 1.494 | 0 | 21 |
| Ch387 (V56) | 59.6 | 19 | 3.396* | 4 | 23 |
| Ch388 (V57) | 71.4 | 8 | 1.739 | 0 | 8 |
| Ch389 (V58) | 68.4 | 13 | 1.606 | 0 | 13 |
| Ch393 (V61) | 79.0 | 2 | 1.464 | 0 | 2 |
| MC4 (V63) | 69.4 | 11 | 3.575* | 4 | 15 |
| Indian Sanam (V64) | 63.3 | 18 | 4.945** | 8 | 26 |

*, ** @ Statistically significant @ $P \leq 0.05$(5%), $P \leq 0.01$ (1%) respectively

Table 4.26.1. Ranking and stability rating (according to Kang 1991a) for plant height and days to harvest of chilli

| Variety | Days to harvest | | | | | Plant height (cm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Rank (y) | $\sigma^2_i$ | Stability rating (z) | Rank Sum (y+z) | Mean | Rank (y) | $\sigma^2_i$ x 1000 | Stability rating (z) | Rank Sum (y+z) |
| Ch291-P(V1) | 86.4 | 16 | 147.88 | 0 | 16 | 60.6 | 9 | 138.75 | 0 | 9 |
| Ch254(V9) | 82.5 | 10 | 22.07 | 0 | 10 | 57.4 | 14 | 80.51 | 0 | 14 |
| Ch2846(V15) | 82.3 | 6 | 196.46 | 0 | 6 | 49.6 | 17 | 21.02 | 0 | 17 |
| Purple(V16) | 82.3 | 6 | 50.98 | 0 | 6 | 62.8 | 5 | 113.76 | 0 | 5 |
| XianCh257(V25) | 80.8 | 1 | 122.06 | 0 | 1 | 48.2 | 18 | 73.79 | 0 | 18 |
| Ch252-C(V28) | 82.6 | 10 | 59.70 | 0 | 10 | 62.1 | 7 | 140.25 | 0 | 11 |
| Sri Lanka (V31) | 86.8 | 19 | 94.38 | 0 | 19 | 42.8 | 22 | 205.60* | 4 | 26 |
| Ch291(V32) | 82.1 | 6 | 324.01 | 0 | 6 | 55.3 | 16 | 36.44 | 0 | 16 |
| Hantaka (V36) | 80.9 | 2 | 47.82 | 0 | 2 | 44.9 | 21 | 85.86 | 0 | 21 |
| Taiwan DC (V38) | 86.7 | 17 | 130.46 | 0 | 17 | 47.1 | 19 | 155.67 | 0 | 19 |
| Huey Sithon (V39) | 86.7 | 17 | 191.77 | 0 | 17 | 60.1 | 11 | 80.95 | 0 | 15 |
| Kulai (V40) | 86.9 | 19 | 343.79 | 0 | 19 | 63.7 | 4 | 176.55 | 0 | 4 |
| Brebes (V44) | 81.4 | 4 | 218.62 | 0 | 4 | 55.4 | 15 | 24.68 | 0 | 15 |
| MC11 (V46) | 81.3 | 14 | 36.22 | 0 | 14 | 69.3 | 2 | 57.96 | 0 | 2 |
| Ch252-C-P(V49) | 82.6 | 10 | 44.70 | 0 | 10 | 75.6 | 1 | 140.52 | 0 | 1 |
| Ch385 (V54) | 81.2 | 4 | 254.71 | 0 | 4 | 45.0 | 20 | 158.39 | 0 | 20 |
| Ch387 (V56) | 80.9 | 2 | 25.41 | 0 | 2 | 61.2 | 8 | 171.25 | 0 | 8 |
| Ch388 (V57) | 83.1 | 14 | 32.77 | 0 | 14 | 59.6 | 12 | 187.32 | 0 | 12 |
| Ch389 (V58) | 82.3 | 6 | 35.33 | 0 | 6 | 68.7 | 3 | 106.00 | 0 | 3 |
| Ch393 (V61) | 86.9 | 21 | 52.29 | 0 | 21 | 63.3 | 6 | 260.84* | 4 | 10 |
| MC4 (V63) | 87.3 | 22 | 356.53 | 0 | 22 | 60.6 | 9 | 265.52* | 4 | 13 |
| Indian Sanam (V64) | 82.6 | 10 | 92.88 | 0 | 10 | 59.4 | 13 | 51.87 | 0 | 13 |

*, ** @ Statistically significant @ $P \leq 0.05$(5%), $P \leq 0.01$ (1%) respectively

Table 4.26.2. Ranking and stability rating ( according to Kang 's 1991a) for days to dry, dry weight and conversion rate of chilli

| Variety | Days to dry | | | | | Dry weight | | | | | Conversion rate (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Rank (y) | $\sigma^2_I$ | Stability rating (z) | Rank-Sum (y+z) | Mean | Rank (y) | $\sigma^2_I$ | Stability rating (z) | Rank Sum (y+z) | Mean | Rank (y) | $\sigma^2_I$ | Stability rating (z) | Rank Sum (y+z) |
| Ch291-P(V1) | 15.88 | 17 | 7.12 | 0 | 17 | 30.03 | 21 | 18.50 | 0 | 21 | 15.02 | 21 | 18.5 | 0 | 21 |
| Ch254 (V9) | 15.57 | 15 | 7.17 | 0 | 15 | 35.80 | 14 | 43.37 | 0 | 14 | 17.89 | 14 | 43.37 | 0 | 14 |
| Ch284-6(V15) | 15.41 | 14 | 14.36 | 0 | 14 | 37.15 | 12 | 32.64 | 0 | 12 | 18.58 | 12 | 32.64 | 0 | 12 |
| Purple (V16) | 14.23 | 2 | 8.96 | 0 | 2 | 39.45 | 9 | 35.39 | 0 | 9 | 19.72 | 9 | 35.39 | 0 | 9 |
| Xian Ch257(V25) | 14.91 | 7 | 8.10 | 0 | 7 | 38.74 | 11 | 9.13 | 0 | 11 | 19.36 | 11 | 9.13 | 0 | 11 |
| Ch252-C (V28) | 15.09 | 8 | 13.17 | 0 | 8 | 44.65 | 6 | 50.49 | 0 | 6 | 22.32 | 6 | 50.49* | 4 | 10 |
| Sri Lanka (V31) | 14.61 | 4 | 21.75 | 0 | 4 | 48.03 | 1 | 47.50 | 0 | 1 | 24.01 | 1 | 47.50* | 4 | 5 |
| Ch291(V32) | 14.36 | 3 | 5.31 | 0 | 3 | 33.46 | 18 | 16.99 | 0 | 18 | 16.73 | 18 | 16.99 | 0 | 18 |
| Hantaka (V36) | 15.21 | 10 | 16.35 | 0 | 10 | 39.23 | 10 | 32.97 | 0 | 10 | 19.60 | 10 | 32.97 | 0 | 10 |
| Taiwan DC (V38) | 15.21 | 10 | 5.43 | 0 | 10 | 41.52 | 7 | 31.30 | 0 | 7 | 20.76 | 7 | 31.26 | 0 | 11 |
| Huey Sithon (V39) | 15.21 | 10 | 5.65 | 0 | 10 | 47.07 | 2 | 38.65 | 0 | 2 | 23.53 | 2 | 36.05 | 0 | 10 |
| Kulai (V40) | 16.04 | 18 | 19.41 | 0 | 18 | 34.74 | 17 | 32.21 | 0 | 17 | 17.37 | 17 | 32.2 | 0 | 17 |
| Brebes (V44) | 14.70 | 5 | 12.39 | 0 | 5 | 41.26 | 8 | 32.97 | 0 | 8 | 20.62 | 8 | 32.97 | 0 | 8 |
| MC11 (V46) | 16.61 | 21 | 15.96 | 0 | 21 | 35.53 | 15 | 55.27 | 0 | 15 | 17.76 | 15 | 55.27** | 8 | 23 |
| Ch252-C-P (V49) | 14.71 | 6 | 17.47 | 0 | 6 | 47.08 | 3 | 32.95 | 0 | 3 | 23.13 | 3 | 32.95 | 0 | 3 |
| Ch385 (V54) | 15.39 | 13 | 10.71 | 0 | 13 | 46.22 | 4 | 37.42 | 0 | 4 | 23.10 | 4 | 37.43 | 0 | 12 |
| Ch387 (V56) | 16.36 | 20 | 16.74 | 0 | 20 | 36.03 | 13 | 52.70 | 0 | 13 | 18.31 | 13 | 52.70* | 4 | 17 |
| Ch388(V57) | 15.38 | 12 | 4.74 | 0 | 12 | 30.79 | 19 | 13.86 | 0 | 19 | 15.38 | 19 | 13.87 | 0 | 19 |

*, ** @ Staitically significant @ $P \leq 0.05$(5%), $P \leq 0.01$(1%) respectively

Table 4.27. Ranking and stability rating (according to Kang 1991a) for product colour, percentage of bleaching and capsaicin of chilli

| Variety | Light transmission at 490nm | | | | | Percentage of bleaching (%) | | | | | Capsaicin content (mg/g DWt) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Rank (y) | $\sigma^2 i$ | Stability rating (z) | Rank Sum (y+z) | Mean | Rank (y) | $\sigma^2 i$ x1000 | Stability rating (z) | Rank Sum (y+z) | Mean | Rank (y) | $\sigma^2 i$ | Stability rating (z) | Rank sum (y+z) |
| Ch291-P(V1) | 8.68 | 5 | 60.57** | 8 | 13 | 52.3 | 22 | 1.21** | 8 | 30 | 7.46 | 12 | 17.95** | 8 | 20 |
| Ch254 (V9) | 8.54 | 6 | 29.11* | 4 | 10 | 44.8 | 19 | 2.07** | 8 | 27 | 7.38 | 15 | 8.33 | 0 | 15 |
| Ch284-6(V15) | 7.24 | 14 | 42.20** | 8 | 22 | 42.4 | 17 | 1.51** | 8 | 25 | 6.99 | 20 | 9.44 | 0 | 20 |
| Purple (V16) | 6.73 | 18 | 17.70 | 0 | 18 | 29.9 | 5 | 0.31 | 0 | 5 | 8.09 | 6 | 4.56 | 0 | 6 |
| Xian Ch257(V25) | 7.03 | 15 | 17.84 | 0 | 15 | 34.2 | 11 | 0.52 | 0 | 11 | 8.05 | 7 | 3.97 | 0 | 7 |
| Ch252-C (V28) | 9.45 | 2 | 69.29** | 8 | 10 | 26.4 | 3 | 1.68** | 8 | 11 | 7.91 | 9 | 3.77 | 0 | 9 |
| Sri Lanka (V31) | 7.35 | 13 | 38.33** | 8 | 21 | 30.6 | 6 | 0.62 | 0 | 6 | 8.50 | 3 | 4.09 | 0 | 3 |
| Ch291(V32) | 8.45 | 8 | 29.63* | 4 | 12 | 40.7 | 16 | 2.13** | 8 | 24 | 7.18 | 19 | 3.42 | 0 | 19 |
| Hantaka (V36) | 7.43 | 12 | 24.39* | 4 | 16 | 30.9 | 7 | 1.27** | 8 | 15 | 7.41 | 14 | 9.6 | 0 | 14 |
| Taiwan DC (V38) | 9.47 | 1 | 19.35 | 0 | 1 | 42.5 | 18 | 1.09** | 8 | 26 | 7.42 | 13 | 8.15 | 0 | 13 |
| Huey Sithon (V39) | 5.57 | 22 | 14.29 | 0 | 22 | 23.9 | 2 | 0.78* | 4 | 6 | 8.76 | 2 | 9.03 | 0 | 2 |
| Kulai (V40) | 7.92 | 10 | 38.62** | 8 | 18 | 45.7 | 20 | 0.82* | 4 | 24 | 7.39 | 16 | 4.15 | 0 | 16 |
| Brebes (V44) | 7.63 | 11 | 15.64 | 4 | 11 | 32.7 | 9 | 0.29** | 8 | 17 | 7.86 | 10 | 3.133 | 0 | 10 |
| MC11 (V46) | 9.36 | 3 | 42.72** | 8 | 11 | 35.6 | 12 | 0.57 | 0 | 12 | 7.21 | 18 | 9.25 | 0 | 18 |
| Ch252-c(P) (V49) | 6.05 | 20 | 24.19* | 4 | 24 | 16.0 | 1 | 0.39 | 0 | 1 | 9.41 | 1 | 5.755 | 0 | 1 |
| Ch385 (V54) | 6.99 | 16 | 16.59 | 0 | 16 | 28.6 | 4 | 0.57 | 0 | 4 | 8.50 | 4 | 12.76** | 8 | 12 |
| Ch387 (V56) | 6.34 | 19 | 37.44** | 8 | 25 | 32.8 | 10 | 0.89* | 4 | 14 | 6.80 | 21 | 9.19 | 0 | 21 |
| Ch388(V57) | 8.13 | 9 | 60.56** | 8 | 17 | 36.9 | 13 | 1.39** | 8 | 21 | 7.80 | 11 | 12.81** | 8 | 19 |
| Ch3889(V58) | 8.97 | 4 | 35.66** | 8 | 412 | 39.7 | 15 | 1.19** | 8 | 23 | 6.79 | 22 | 12.66* | 4 | 26 |
| Ch393(V61) | 5.88 | 21 | 21.29 | 0 | 21 | 39.6 | 14 | 0.89* | 4 | 18 | 8.20 | 5 | 7.89 | 0 | 5 |
| MC4 (V63) | 8.48 | 7 | 26.45* | 4 | 11 | 48.6 | 21 | 0.87* | 4 | 25 | 7.34 | 17 | 4.65 | 0 | 17 |
| Indian Sanam (V64) | 6.85 | 17 | 44.81** | 8 | 25 | 31.0 | 8 | 0.88* | 4 | 16 | 7.99 | 8 | 1.77 | 0 | 8 |

*, ** @ Statistically significant @ $P \leq 0.05$(5%), $P \leq 0.01$(1%) respectively